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Time-Magnification Study of a Rattlesnake Strike

By SAM C. DUNTON and HENRY M. LESTER

An ultra-slow motion-picture sequence of a rattlesnake's strike was required to disclose detail in certain mechanical aspects of this generally unpredictable action, as part of an education film on the behavior of reptiles. The authors, assisted by the Zoo's staff, succeeded in recording this event in color at 2400 pictures per second. The assignment was completed in 8 months. The approach to the problem and the method of synchronization are described.

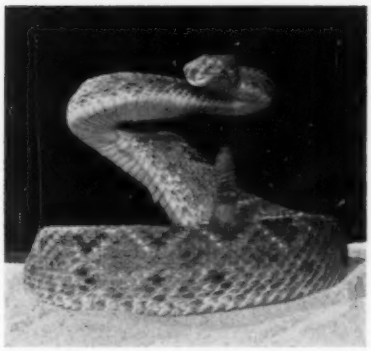


Fig. 1. Herman.
A ferocious Western Diamondback Rattlesnake — ready to strike, his rattle sounding, his forked tongue sensing . . .

The microscope makes it possible for the human eye to examine the structure of *matter* by magnifying its detail. The high-speed motion-picture camera reveals the detail in rapid *motion* by slowing it down to the point at which a blur is resolved into its component movements. Thus, a motion-picture camera capable of taking pictures at a rate higher than that at which these pictures are to be projected is aptly referred to as a "time magnifier" or a "time microscope," depending upon the ratio between the rate of taking and projecting the pictures.

The New York Zoological Society, in the course of producing a series of films on *Living Reptiles*, dealing with, among other things, their defensive and offensive behavior, wished to show in detail how a rattlesnake strikes, a common enough event about the mechanics of which comparatively little is known. To an unaided eye it invariably looks like a blur. At first, the problem seemed no more complicated than some of the problems encountered in earlier studies of the flight of a hummingbird and of a drone fly. Calculations based upon measurements made from high-speed still photographs of rattlesnakes striking* put the total duration of a strike at about $\frac{1}{8}$ sec. Thus, if the high-speed motion-picture camera could record this action at a time magnification of from 100 to 125 times, the resulting film could be expected to show the entire event occurring at a pace slow enough for detailed study.

Preliminary experiments with available snakes disclosed an important fundamental difference between a strike and a flight: the latter is a more or less continuous action causing the bird or the insect to move in space but the strike of a snake is a transient event, unpredictable in at least one dimension—*time*. High-speed still photographs of the strike at practically any point of its trajectory are entirely feasible. Many such excellent pictures have been made by several workers in this field. Among them, Van Riper's high-speed still photographs of rattlesnakes striking are probably the most revealing. These photographs have disclosed much information about the speed of the strike at various ambient temperatures.*

Early in the investigation it became apparent that high-speed motion-picture studies of this action would be considerably more complicated than their still equivalents. A captive rattlesnake is not easily provoked to strike, especially at an inanimate target. Most snakes would not strike at all, and the few that did, struck erratically and unpredictably. The unpredictability of the strike is in "the nature of the beast," and an essential part of the effectiveness of the animal's attack. Photographically, this proved to be a serious obstacle. Inability to find a workable stimulus or means of provoking the snake to strike at a target with any degree of consistency made the task quite difficult. The high-speed motion-picture camera requires about $\frac{1}{2}$ to $\frac{3}{4}$ sec to reach its effective operating speed, and, upon attaining it, it cannot be stopped. Depending upon the chosen operating rate, the useful time of operation at that speed is about one second—the critically brief length of time during which the action must take place.

Problem of Illumination

Another problem which complicated this assignment was that of illumination, an important requirement for operation of the high-speed camera. At 3000 pictures per second, each individual frame is exposed to the action of light for only 1/15,000 sec. Much light is needed for exposures of such brevity, and a large amount of light ordinarily generates a corresponding degree of heat and neither light nor heat helps to induce normal behavior in a snake. A snake excessively disturbed by too many factors will not strike. Continuous flash equipment had been successfully used for high-speed motion-picture studies of hummingbirds, flies and other living subjects. This equipment consists of a pair of large reflectors within which revolve 17 flashlamps firing consecutively. Two such units, flashing a total of 34 focal-plane flashlamps (GE FP #31) with both beams of light super-

Presented on October 8, 1957, at the Society's Convention at Philadelphia by Sam C. Dunton, Staff Photographer for the New York Zoological Society and the New York Aquarium, and Henry M. Lester (who read the paper), Photographic Consultant, 270 West End Ave., New York 23. (This paper was received on September 30, 1957.)

* Walker Van Riper, "Measuring the speed of a rattlesnake's strike," *Animal Kingdom* (*N.Y.Z.S.*), *vol. LVII*, no. 2, Mar.-Apr. 1954.

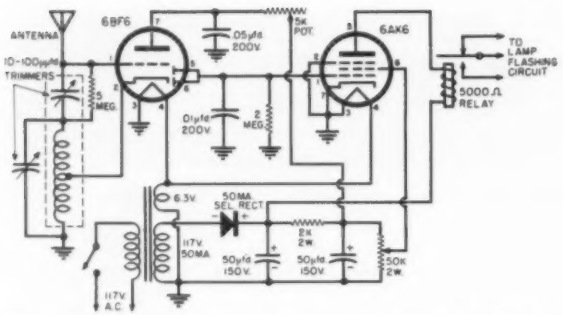


Fig. 2. Capacitance relay used to close the flashing circuit of the continuous flash units. Values of standard components are shown. The system was grounded through a cold-water pipe. Copper screening placed between the snake and target served as the "antenna," forming a well-defined demarcation line.

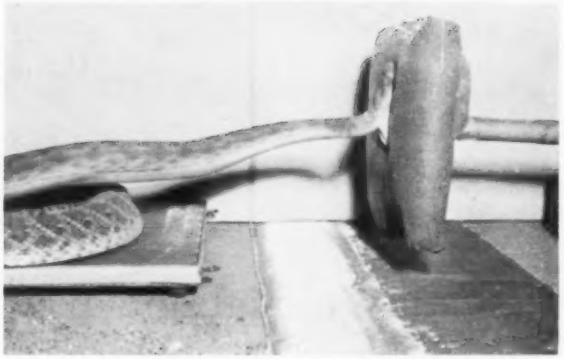


Fig. 3. A close-up of an effective, well-aimed strike made by a rattlesnake. An electronic flash photograph at 1/1000 sec: it did not stop the movement of the forward part of the snake's body.

imposed upon the subject, emit a total of about 3 million lumens of light — substantially more than the illumination available from July or August sunlight. This truly stunning illumination lasts only for one second, but since the useful running time of the camera is also just about one second, when the camera and lights work as a well-synchronized unit, some 65 to 70 ft of film can be exposed by the total of light emitted, with an abundance of illumination that would be difficult to secure in any other way. With so much light available, it is not necessary to work close to the borderline of underexposure even when using color film. The added advantage of the continuous flash is that this light source does not radiate much heat upon the subject. The heat is largely dissipated as the flashing lights revolve, which makes the lighting cycle too brief to impart to the subject more than a passing sensation of warmth.

Ordinarily, synchronizing the flashing lamps with the useful run of the camera is quite simple. The camera used—the Kodak High-Speed Camera, Type III — has a built-in switch for closing (or opening) an external electric circuit which is actuated by a cam adjustable to function at any point along the length of the film as it passes through the film gate. The rotors of continuous flash units are made to revolve, the camera is started, and, at a predetermined point of the camera's run, the flashing battery circuit is closed, and the one-second flashing cycle is automatically started. But inducing the snake to strike during that critical and transitory *one second* when the camera and the lights were on was far from an automatic process.

The working team (James A. Oliver, Curator of Reptiles; Stephen Spencook, Head Keeper of Reptiles; William Bridges, Curator of Publications) and the authors worked for weeks, trying all sorts of targets, including Dr. Oliver's legs (in snake-proof trousers and boots, of course!), all to no avail. More than 20 rattlesnakes were flown in from Texas at various times, always with assurances from the suppliers that "this lot is really hot." To induce the snakes to strike during the critical one-second period, amplified audio oscillations ranging from 20 to 20,000 cycles/sec were conveyed to the animal either aurally or by indirect physical contact with its body. This had no effect whatever. Injection of hormones was tried and made the snakes more aggressive but did not make their strikes any more predictable. The original plan to secure a record of a strike through persistent attempts proved entirely impractical. As the year drew to a close and the snakes grew more lethargic, flashlamps and film were used up and the operation had to be suspended for the winter.

Then, in a shipment of snakes received from Texas early the following spring appeared a really "hot" rattlesnake, a large, almost 6-ft long specimen that struck at anything in sight at the slightest provocation (Fig. 1). The snake was promptly isolated to protect it from all unnecessary disturbances, and it was named Herman.

The method of approach was revised along more realistic lines to extend the usefulness of the fresh stocks of film and flashlamps, and thereby better the probability of recording a strike before running out of either. Up to that time, each exposure cost $20.00 for film and lamps, whether the snake did or did not strike. Since neither money nor snakes grew on the trees of the Zoo in New York, the team had to make do with what was on hand. The responsibility for the closing of the flashing circuit was shifted from the camera to the snake, so that this would become a function of the first perceptible movement of the snake's head towards the target, while the camera was at its useful operating speed and the lamp rotors were revolving.

The brilliant flash of light occurring just before the snake might have struck had been observed to have both a stunning and a blinding effect upon the animal, and was thought to be the cause of many failures of the snake to strike at times when, from all indications, he was about to have lunged toward the target. It could be assumed that, once the snake started out in the direction of the target, the flash occurring after the strike was initiated would not be likely to interfere with its completion. If the snake failed to strike after the camera was set in motion, the flashlamps would not go off at all, and flashlamps and film could be reused for the next try, since the film would not be exposed in the relatively low level of ambient illumination prevailing on the mezzanine of the Zoo's Reptile House.

The conventional method of having the head of the snake interrupt the light beam of an electric eye was considered for this application, but it was found that the cone of light would be too confining for the erratic movement of the snake. Also, this system could be triggered inadvertently by the hand-operated target. Instead, a sensitive capacitance relay was designed and built to aid in establishing a well-defined sphere of sensitivity between the snake and the target (Fig. 2). The introduction of a conductor of electricity anywhere within that sphere would cause a disturbance resulting in the instant closing of the flashing circuit. The target, a 12 by 12-in. board covered with foam rubber padding over which a piece of thin red leather was stretched, was secured to the end of a 5-ft bamboo pole and could be moved freely within this sphere without affecting the relay.

Tests proved that the snake could be made an effective conductor, and that the reptile would activate the relay instantly upon crossing a distinctive line of demarcation. Hours, days and even weeks of time were saved as well as material when all test photographs of the snake striking the target were made on Polaroid film (Fig. 3). These almost instantly available stills were made under conditions of lighting and exposure which

made it possible to calculate correct exposures applicable to the high-speed motion pictures that were to follow.

Snake Platform Constructed

The work with the rattlesnakes was carried on upon a specially constructed platform measuring 4 ft in depth, and 6 ft in width. It was open and accessible from three sides, the fourth side being provided with a 3-ft-high background marked off with a grid of 1-in. squares to one side of a vertical stripe, which indicated visually the line of demarcation established for the capacitance relay. Because of objectionable reflections, a plate glass shield was not used to separate the working team from the snake. The safety of the cameramen was confidently entrusted to the skill and competence of the "snake handlers" of the Zoo's Reptile Dept. A small wooden platform, about 15 by 20 in., mounted on casters for easy positioning, was provided as a firm but movable support for the snake. The platform was covered with copper screening connected by a flexible wire to the chassis of the capacitance relay. The copper screening thus not only grounded the snake, but provided the necessary secure footing for the coiled snake (Fig. 4).

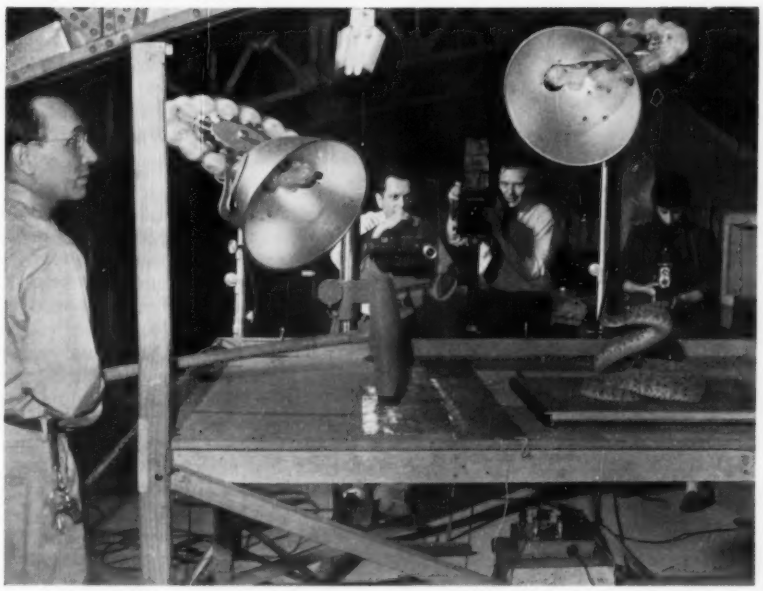


Fig. 4. Setup used for high-speed photography of a rattlesnake strike. The continuous flash lights are revolving and the snake is ready to strike the target. The capacitance relay is beneath the platform. Copper screening under the target acts as the "antenna" and similar screening secured to the small movable platform under the snake acts as the "ground." The background panel was removed for this photograph.

It was soon apparent that even a ferocious rattlesnake cannot be expected to strike interminably. A strike is to a snake a supreme physical effort, and even Herman showed visible signs of fatigue after the fourth or fifth strike of the day. We had to limit ourselves to the very minimum of strikes per day, and, at times, had to employ other snakes as stand-ins for tests and checking, to preserve Herman's striking power for efforts that would really matter. Working with wild animals calls for infinite patience and complete immunity to the frustration that may result when the most carefully laid plans fail as a consequence of animal and man thinking on different wavelengths.

The new approach proved effective from the start. The team was getting pictures, motion pictures, that is! But efforts to effect a complete synchronization of the actions and reactions of man, reptile and machinery were not successful until man learned to recognize the snake's minutest movements as indicative of readiness to strike. The sensing of the capacitance relay was adjusted to a trigger-like point, and it became impossible for anyone to get close to the platform without tripping the relay.

Finally, on April 1 of that memorable spring, Herman struck at the right time! All signals were perfectly timed, and all actions for which these signals called occurred as planned: the snake lunged forward while the camera was running, and the lights went on. When all was over, and when the team regained its vision after the blinding 1-sec flash, Herman was back in his stance, coiled like a steel spring, ready to strike again. Every member of the team shared the excitement of getting a picture. Success was confirmed when the footage came back from the processing laboratory. Oddly enough, this was the only fully recorded good strike in the 8 months spent upon this project. Several other strikes were recorded but for various reasons, none of these was complete or usable. Some strikes never reached the target, or missed it altogether. Other strikes were made by an obviously tired snake, whose jaws were never opened, with the target merely grazed by the snake's head. But there was something in each of these incomplete views that, when added to the one perfect strike, provided interesting additional information to round out and complement the basic good strike (Fig. 5).

Herman Struck Out

It seems that Herman's strike, so effectively and viciously placed squarely in the center of the target on April 1—jaws opened to the full 180° of their capacity, venom obviously starting to flow out of his hypodermic needle fangs even before reaching the target—was made at the very peak of his brief but useful career. He never delivered another strike like it, and he died shortly afterwards. Obviously, Herman just "struck himself out!"

The total usable footage secured through this investigation was less than 100 ft. To get this, a team of five men, aided by the Zoo's carpenters, electricians, machinists and assistant keepers, worked for about 8 months. When not actually photographing, the team was thinking, planning and scheming. Twenty-six rattlesnakes were flown in from Texas, and about 6000 feet of motion-picture film and 3500 flashlamps were used up in this undertaking. Much auxiliary equipment was built, rebuilt, tried, discarded, and replaced by other devices.

Most of the footage secured was made on Kodachrome Film, Type A. The lens used throughout this work was Kodak Cine Ektar, 25mm, $f/1.9$ at $f/4.5$. The Kodak High-Speed Camera, Type III, was set to operate at not over 2400 pictures/sec, which provided a useful operating time of slightly over $1\frac{1}{4}$ sec, and, since the end results were going to be projected ultimately with sound added at 24 frames/sec, it yielded a time magnification of 100 times, a convenient figure to use in educational films.

The end result of this time magnification of a strike of a rattlesnake is not fully realized when merely viewed on the screen as a study of slowed-down motion. The 1-in. grid provided upon the background, coupled with the timing pulse made in the camera upon the edge of the film as it moved past the film gate at some 40 to 45 miles per hour, provided the scientific staff of the New York Zoological Society with considerable material for calculations from which

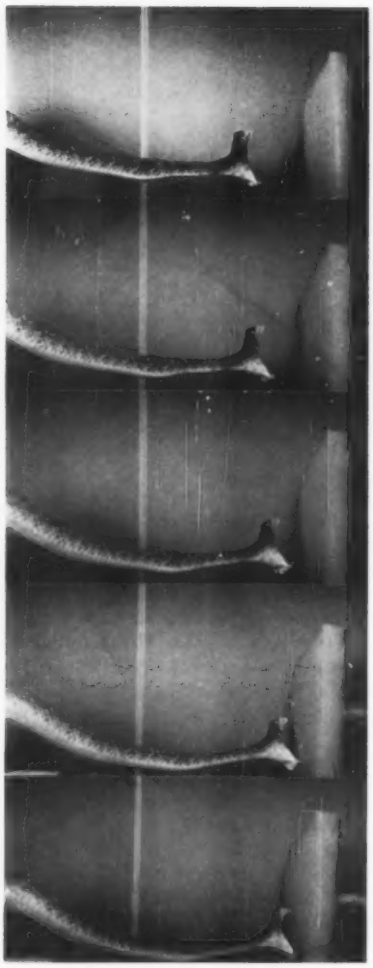


Fig. 5. A set of 10 enlargements from 16mm frames of Kodachrome film, showing successive steps of a rattlesnake striking at a target. The vertical strip of tape — the demarcation line — conceals a copper wire, part of the antenna of the capacitance relay. .

they are able to learn much about the kinetics and dynamics of the strike of a rattlesnake.

Herpetologists have not been able to find enough evidence, up to now, to agree on whether the strike of a rattlesnake is a stab or a bite. The film, so far, indicates that the strike is definitely a stab at first, and, depending upon the physical shape of the target, it later becomes a bite. At times, venom starts flowing out of the fangs before the target is reached.

Van Riper's estimate of the average speed of the snake's head during the strike was 8.1 ft/sec. Some portions of the footage offer evidence that the snake's head moves at times as fast as 20 ft/sec, but since that speed is not maintained uniformly at every point of the trajectory, this information may not be conclusive.

Further Studies Planned

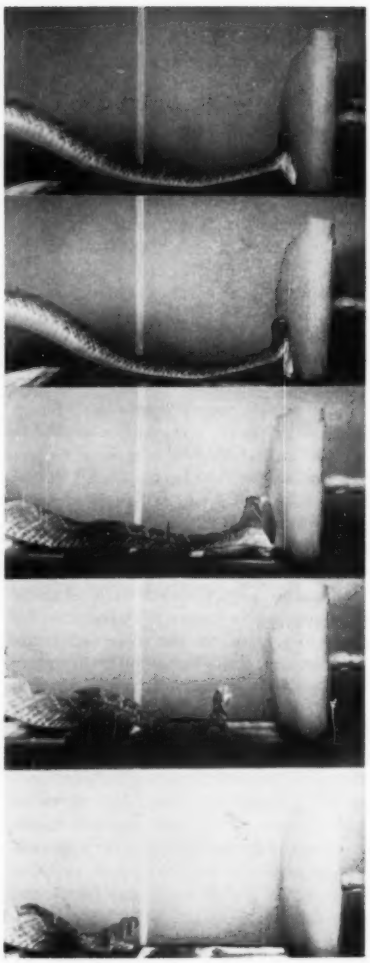
Encouraged by the results obtained so far, members of the team feel that this work has enriched us with a great deal of information, and the methods employed in the photography of this action hold promise of additional disclosures possible in this area. Scientists would like to know more, for instance, about the amount of energy expended by the snake for a strike, how this amount of energy is related to the snake's food intake, how the snake's metabolism is affected and to what extent the snake's vitality and fatigue are involved. Scientific investigation through photography is broadly accepted by the scientists of the New York Zoological Society, and this work is to be continued within the limitations imposed by availability of funds for research.

Since this report was prepared, further investigation into the possible methods of recording transient actions of animals has been initiated. The electronic capacitance relay described here, the electric eye, will find additional applications in the work. In further studies of snakes, frogs and other animals another device will be used, the operation of which is based upon one of the laws of motion: to every action there is an equal and opposite reaction. A lightweight balsa wood platform capable of very small movement within a rigid frame has been built. Provided with small nylon rollers or ball bearings which rest upon plate glass, the platform can touch, by its leading edge, a sensitive leaf switch to hold an electric circuit open. A snake or a frog reposing upon such platform will cause a recoil upon the slightest attempt to strike or leap. This will close the circuit, since a movement as small as $\frac{1}{32}$ in. is sufficient to accomplish it. The closing of the circuit in this manner can accomplish many things, among them, closing the flashing circuit described here. It will accomplish this in less time than the capacitance relay with its normal time lag, however small.

With the capacitance relay, it was thought that we were trailing the snake's decision to strike by about 10 to 20 msec, depending upon the snake's distance from the "demarcation line." With the "inertia platform" it is believed that that margin has been reduced by at least 50%—down to about 5 to 10 msec. This is perhaps the closest possible approach to the design of a much needed "anticipator" of action on the part of things that live!

Discussion

John R. Waddell (Fairchild Camera & Instrument Corp.): Have you tried an electric shock as a means of getting the snake to strike? I recall taking some pictures of a frog and poking it with our fingers, even jabbing it with a needle, but it refused to jump until we applied 30 volts of electricity — when it took off very rapidly.



Mr. Lester: The snake's usual reaction is to turn in the direction from which the shock or stimulus comes. He will not strike forward at the target. Sometimes the snake will crawl off the platform and seek a quiet corner where he will not be disturbed. The snake must feel secure in his basic coil before he will strike.

W. O. S. Johnson (E. I. du Pont de Nemours & Co.): You mentioned a platform on rollers. Is this a device to anticipate the snake's striking, and is there a possibility of its being used as a means of gathering energy data?

Mr. Lester: No, the rollers were actually silent domes which permitted us to move the board into a position just before triggering the relay. If the snake coiled too far away from the target, the rollers made it comparatively easy for us to move the board forward to the desired position.

Mr. Johnson: In asking the question about using the platform to anticipate the snake's actions, I had in mind a LaRue platform which has been developed and upon which our Du Pont psychologists have done considerable work in measuring the energy expanded in such activities as walking, lifting, running a lathe, etc. An adaption of this LaRue platform might give you the kind of information you require. It can measure directly the reaction force in each of three axes.

Mr. Lester: I am most grateful for this suggestion. We are receptive to any ideas that will enable us to work successfully with reptiles or with animals.

Mr. Johnson: I believe this platform has been applied to the study of the behavior of dogs and other animals. I'm quite sure that it has not yet been applied to the study of snakes.

Photographic Instrumentation for Collision Injury Research

By DERWYN M. SEVERY

Forty-four experimental automobile collisions were conducted. A study was made of the two impacts that are part of every collision: first, the contact between the two automobiles; and second, the contact between the occupants and the interiors of the automobiles. Special photographic methods permitted collection of precise quantitative data as well as important qualitative information about these crashes. Superposition of before and after photos of the underbody of each vehicle facilitated analysis of the deformation of each car's structure. Camera coverage from every important angle was used to supplement the extensive electronic instrumentation designed to record the tremendous forces involved in each collision. High-speed motion-picture cameras provided the primary data for special aspects of the 50-mph head-on crashes. Photographic close-ups of the rapid sequences of injury-producing events have provided new and otherwise unobtainable scientific insight into the mechanisms of injuries in these events.

A new approach in combating death and injury on the highway was initiated in 1948 by the Institute of Transportation and Traffic Engineering, University of California. This approach stemmed from the concept that a certain number of automobile collisions are inevitable but that the resulting injuries are, to a large extent, preventable.* An engineering study of automobile collisions was undertaken to determine the mechanism of injury production as a step toward making engineering revisions that would reduce and in many cases eliminate injuries resulting from collisions. Preliminary evaluation was made of three approaches to the problem: (1) the laboratory experimental procedure, (2) the collection and subsequent analysis of data at the scene of accidents and (3) the conduct of full-scale automobile impact experiments. This preliminary evaluation led to the conclusion that the latter approach, the conduct of full-scale automobile collision experiments, was the only method which would provide precise engineering data.

Nearly four years were required to develop specialized equipment necessary for this research. During this developmental period, familiarity with the problems of instrumenting the automobile collision was provided by attempts to derive collision data from vehicles used by stunt drivers for the collision exhibition portion of their shows.

The only instrumentation that provided acceptable data for these early collision experiments was a single high-speed motion-picture camera. Since each car had an independent speed which would not be maintained at a preassigned speed or even at a constant speed, the point of impact could not be accurately anticipated. This made it necessary for the high-speed camera to be panned and stopped at precisely the correct instant at the point of impact. Frequently, this resulted in loss of photographic coverage, or in results such as are shown in Fig. 1.

Seven years and forty-four experiments later, considerable improvement had been made in photographic instrumentation of the automobile collision (Fig. 2).† In addition to improvement in quality, photographic coverage has increased from the single high-speed camera used in 1950 to current use of thirteen cameras and accessory photographic equipment.

Operational Procedure

Experiments which eat up research funds at a rate of $40,000 a second require extremely careful planning and particular attention to operational details to minimize the chance of loss of data through any one of a multitude of system failure potentialities. For example, following an experiment the many rolls of expended film are divided into two carefully selected groups so that each group maximizes the photographic coverage. These groups are processed by the laboratory independently so that an unfortunate error would not result in the destruction of irreplaceable photographic data for an experiment. From the point of view of the researcher, the automobile collision may be characterized as an extremely complicated phenomenon of very brief duration ending in destruction. This definition explains the reasons why even the *planned* automobile collision is difficult to instrument.

Presented on November 19, 1957, at the Hollywood Section meeting, by Derwyn M. Severy, Institute of Transportation and Traffic Engineering, University of California, Los Angeles 24.
(This paper was received on November 18, 1957.)

*This concept is not in conflict with the statement that injuries are prevented by preventing accidents. It simply recognizes the limitations of accident prevention measures and deals directly with the sequential important issue, the reduction of motorist injuries.

†Research sponsored by Parish Pressed Steel, a Division of the Dana Corporation.

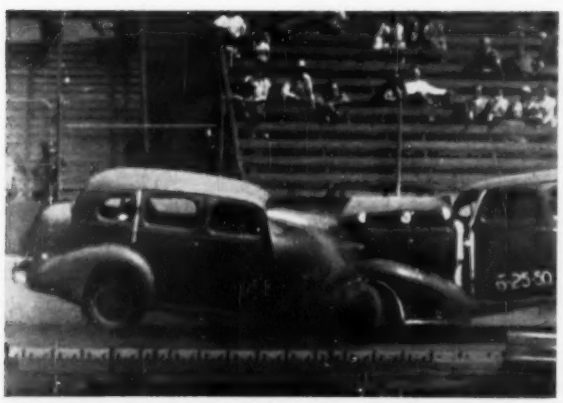


Fig. 1. Example of photographic coverage of head-on collision at approximately 35 mph, using early methods.

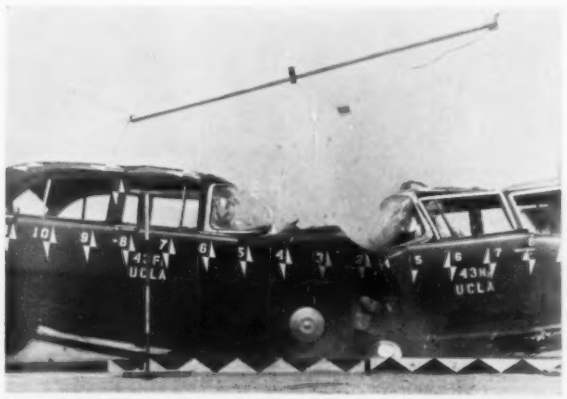


Fig. 2. Head-on collision at 50 mph, photographed with current methods.

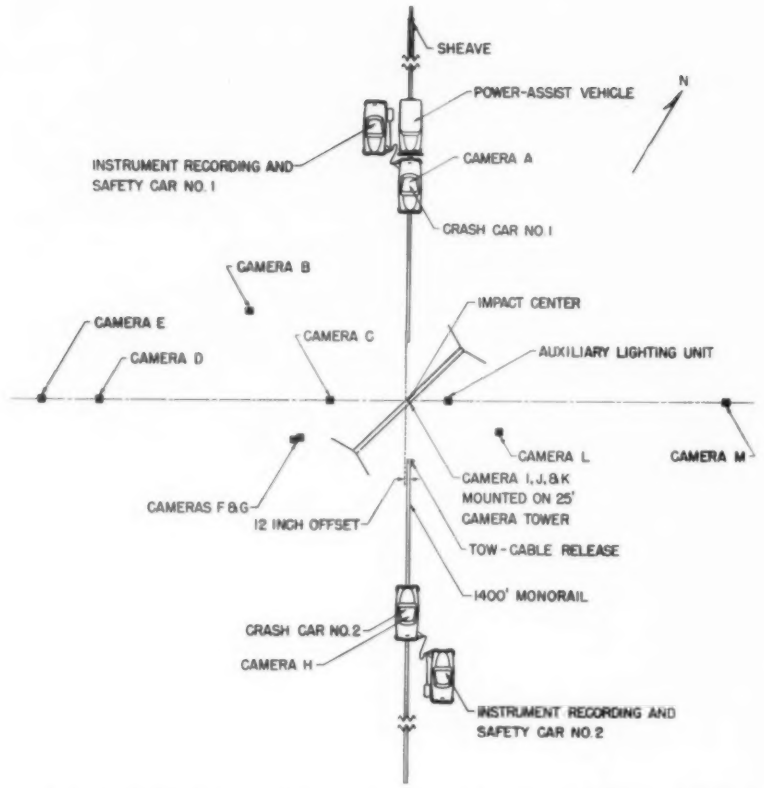


Fig. 3. Photographic instrumentation for experimental head-on collisions; see Table I for corresponding camera data.

The Point of Impact

It is important, for purposes of photographic instrumentation, to have a predesignated nonshifting point of impact. Vehicle to fixed barrier, car-to-car rear-end collisions, and recent experiments involving head-on collisions were planned to make sure that the impact would occur in full view of all cameras. The specifications considered necessary for successful head-on collision experiments provided for an allowable error of ± 6 in. from impact point along the 1400-ft pre-crash axes of approach, ± 2 in. maximum lateral displacement of one car relative to the other, even for speeds to 50 mph. This means that each car must be steered within 1 inch of the precise course, a degree of precision neither consistantly nor generally possible by human operation. The cars were required to have identical speeds within ± 2 mph of the designated crash speed. A further stipulation was that both cars on impact were to be completely free of speed and directional constraining influences. Several different vehicle control systems were used in earlier experiments but none of them, including the human operator, could perform with the degree of precision prescribed for head-on collisions.

Specifications for directional control were met by the use of an aluminum ground-level monorail guide system extending 1400 ft in opposite directions from the impact point. Specifications for point of impact with respect to the axis of approach were met through the use of a $\frac{3}{8}$-in. steel cable connected to the rear car, No. 1, thence passing through a sheave anchored at the end of the track behind car No. 1 and back under car No. 1 to the front end of car No. 2 positioned at the other end of the track. Car No. 1 pulled car No. 2 into itself (Figure 3). Their approach speeds were therefore the same and were controlled by a governor on the power car (No. 1). The cable was released a split second before impact. The cars were guided down the monorail by a phenolic shoe which slid along inside the U-shaped rail. This shoe was fastened by a yoke extending from the shoe to the front bumper. The track terminated 20 ft from the impact point thus eliminating the constraining influence of the track during impact.

Camera Tower

The system just described for controlling vehicles during acceleration and later steady-speed cruising to the place of impact was found to be entirely satisfactory operationally and especially well suited to photographic instrumentation. Cameras could be moved in as close to the impact area as desired and positioned at every important angle about the perimeter of the impact area. Two important dimensions were, however, excluded from photographic coverage, one being vertically downward to provide a birdseye view of the collision and the other vertically upward to provide opportunity to study the collision per-

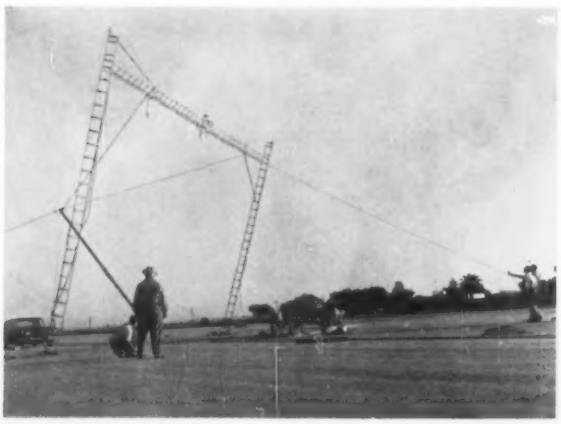


Fig. 4. The camera tower.



Fig. 5. Precision timed photograph taken from camera tower.

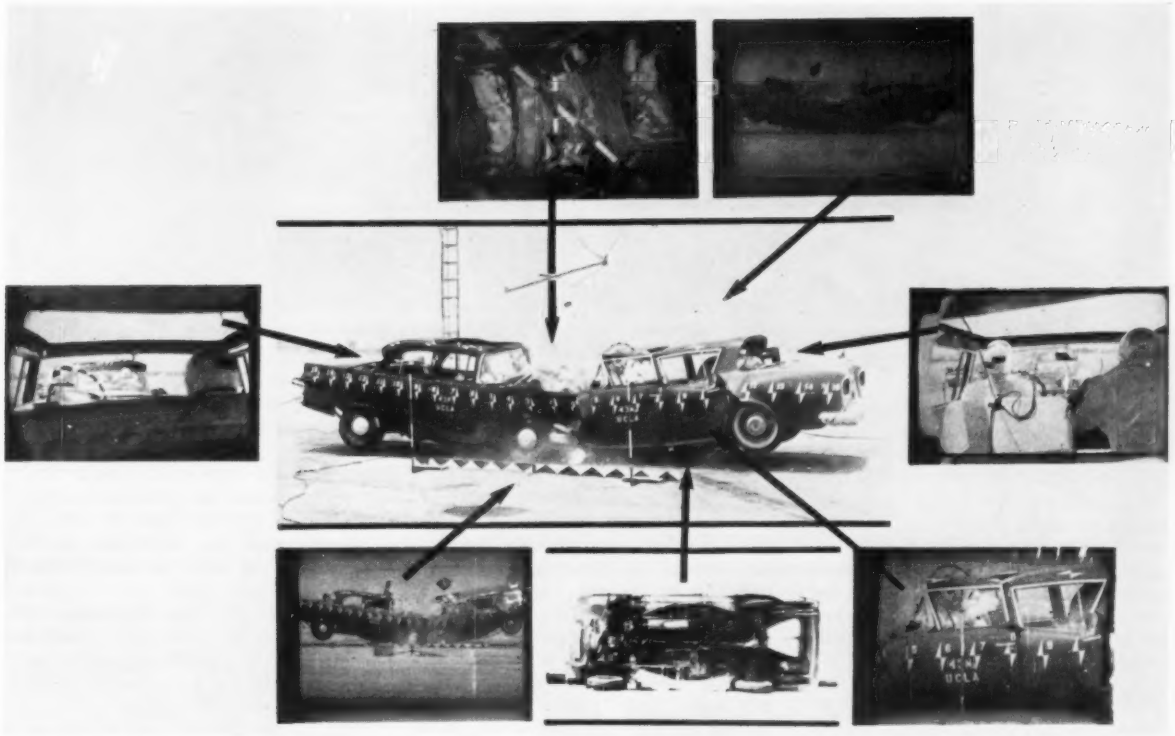


Fig. 6. Three dimensional photographic coverage.

formance of the frame and general underbody configuration of the automobile. To accomplish the first mentioned coverage, two 30-ft high steel towers and a 50-ft horizontal crossmember were designed and erected to support vertically oriented cameras 26 ft above ground level (Fig. 4). In order to permit the tower cameras to photograph the impact of the car occupants with the car interior, the sheet metal of the roof above the front seat area was cut away from both cars (Fig. 5).

Three-Dimensional Photographic Coverage

To secure photographic coverage of the car frame and general underbody area during collision, it would have been necessary to provide a camera pit at the impact point or to cope with difficulties of comparable magnitude for other solutions that were considered. Consequently, due to the usual situation — limited research funds — the task of underbody photography during the collision event was not fully accomplished for the experiments being described. Instead, a system involving pre- and post-crash underbody photographs was devised to permit their superposition so that all collision deformations of the underbody could be measured on a composite photograph with an acceptable degree of accuracy. Some motion-picture coverage of the underbody during collision was provided by the ground level high-speed cameras located to the side of the cars during impact. This was possible because on impact some underbody structures, such as the drive shaft, were forced below the frame line into the cameras' view and especially because the rear of the cars pitched upward exposing additional understructure to the cameras. The three-dimensional photographic coverage of the automobile collision is to some extent indicated in Fig. 6.

High-Speed Camera Operation Technique

Mobile power units were required at the test site. All photographic equipment received power from a 5-kw motor-generator unit. The order in which the cameras were switched on was determined from evaluation of their respective acceleration rates under field operating conditions. This procedure for sequential starting also served the purpose of spreading the starting load over a longer period of time thus avoiding the possibility of overloading the portable generator at a critical moment. At this point a question may well be asked: Why was an operation of this scope and calibre conducted using manual rather than automatic starting techniques for the cameras? Experience with relay and comparable system failures in the past has led to the conviction that application of complete automation would compromise the security of operations in view of the proven reliability of the trained experimenter to handle effectively not only routine runs but also the problems of judging corrections required when a malfunction develops during a run.

Automation was applied to those operational functions requiring a level of performance not possible by manual control. Examples are: (1) An electronic time-delay unit was built to actuate still cameras with millisecond precision. (2) A photocell-flashbulb device was developed to provide a basis for synchronizing high-speed cameras with the recording oscillograph also operating at high speed. (3) Auxiliary lighting was accomplished by a brief but very effective sequentially fired flashbulb unit. These systems are further described in the report.

The Eastman and Fastax high-speed cameras were positioned, checked for electrical continuity and operation, adjusted and locked in a protective enclosure on the day preceding the experiment. On the day of the experiment, removal of the protective weather enclosure and similar minor adjustments were all that were required for these cameras. This allowed time to set up the two moderately high-speed GSAP cameras required in the crash cars as well as the high-speed camera which was positioned very close to the impact for special study of a particular collision phenomenon. In addition, the more quickly installed devices such as electronic time-delay cameras, auxiliary



Fig. 7. Crash car connected to monorail guide. Instrument car at left.

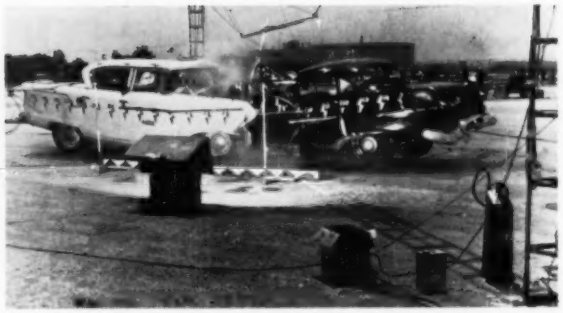


Fig. 8. These cars approached each other at 102 mph.

lighting unit, calibrated and fixed reference markers were positioned. By distributing photographic instrumentation preparations over a two-day period, the project engineer was able to manage directly all motion-picture photography serving the primary purpose of providing technical data. Consequently, the normal attrition of technical personnel during the past several years of experimentation has not affected progress in photographic instrumentation.

The Experimental Collision

Optimum sunlight for photographing experimental collisions is obtained around noon. The entire morning is spent making final checks on the 12 independent systems of instrumentation. When the operational Control Board shows that all preparations have been completed, the project engineer takes his station at the power control unit situated adjacent to the impact point. He is in telephone communication with each instrument recording vehicle positioned next to its respective crash car at opposite ends of the track (Fig. 7). At this point the project engineer announces "Minus Five Minutes" which initiates a series of last-minute instrumentation and general operational checks. With an "all clear to commence run" from the project engineer, the crash car is pushed to cruising speed by a power-assist vehicle. As the primary crash car is pushed forward, the cable-pulley system connecting the two collision cars prevents any differences from developing in their respective speeds.

At the instant the power-assist vehicle accelerates the cars past 5 mph, the primary crash car engine starts automatically and with the assist vehicle pushing, both crash cars accelerate rapidly to a cruise condition. The governor on the primary car holds the collision car speeds constant until impact. If during the run a malfunction occurs, the instrumentation engineers may stop the collision vehicles by air brakes operated remotely from their instrument cars. At minus 10 sec from impact the engineers, who are riding in the instrument recording vehicles pacing the crash cars, turn on their recording oscillographs and by remote control start the moderately high speed GSAP cameras mounted in the crash cars. During the minus 10-sec interval the instrument recording cars commence decelerating from their slightly leading position so that the crash cars, maintaining a constant speed, can forge ahead of the instrument cars just before impact (Fig. 8). The momentum of the instrument recording cars carries them to within a few feet of the impact before they are able to stop (Fig. 9). This procedure prevents the 100-ft transducer cable leading from the crash car from being detached just prior to, or during, the impact. The project engineer sequentially energized all high-speed cameras at minus 4 sec.

Table I. Photographic Data for 50-mph Head-on Collision, 1956 Nash vs. 1956 Ford.
Experiment #43 conducted June 12, 1957; time of crash, 1:45 P.M.; weather, ceiling unlimited and visibility unlimited.

Camera	Position (see Fig. 3)	Type of film	*f* setting	Frames/sec, or shutter speed	Distance, (feet)
High-Speed (ITTE) Eastman II 63mm	D	Superior 4* (Du Pont)	2.0	1400	120
High-Speed (ENGR) Eastman I 63mm	E	Superior 4	4.0	900	138
High-Speed Fastax I 50-mm	I	Superior 4	2.7	1400	24
High-Speed (AEC) Eastman II 63mm	F	Superior 4	4.0	600	38
High-Speed Fastax II 25-mm	M	Superior 4	2.8	1400	123
Mod. High-Speed (GSAP) 12.5mm	H-(Nash)	Tri-X Neg. (Eastman)	4.0	200	5.5
Mod. High-Speed (GSAP) 25mm	A-(FORD)	Tri-X Neg.	4.0	200	6
Tower GSAP 17mm	J	Plus X (Eastman)	8.5	64	24
Tower Time-Delay† 127-mm	K	Royal Pan (Eastman)	11.0	1/400	24
Ground Time-Delay† 127-mm	G	Royal Pan	11.0	1/400	10
Ground Time-Delay† 127-mm	C	Royal Pan	11.0	1/400	25
Cine-Pan 25mm	B	914A Du Pont	16	24	60
Cine-Pan Anamorphic Lens	L	914A Du Pont	16; #1 filter	24	31

*Superior 4, Du Pont 928A Negative (footage numbered).
†Speed Graphic cameras controlled by electronic time-delay device.

Photographic Instrumentation

Nine of the 12 systems of instrumentation applied to collision injury research utilized photographic techniques exclusively or as an accessory function. In discussing these applications, certain data will be shown to enable the reader to evaluate the adequacy of the particular technique under discussion. These data are but samples of the very substantial mass of collision research data presented elsewhere.‡

‡Example: D. M. Severy and J. H. Mathewson. "Technical findings from automobile impact studies," *Trans. Soc. Automotive Engineers, 65:* 70–83, 1957.

Information Obtained by High-Speed Motion-Picture Photography

Eastman and Fastax 16mm cameras were used to obtain the following information:

1. Distance-time measurements which could be differentiated to provide:
   (a) Velocity-time
   (b) Acceleration-time — The acceleration-time patterns provided the basic collision deceleration characteristics known as Rate of Onset, Duration and Peak. An explanation and evaluation of the micromotion analysis techniques leading to acceleration pattern data was presented in an earlier paper.§
2. Chronological record of collision events both by general coverage and special studies.
3. Kinematic analyses.
4. Load evaluation.
5. Deformation — elastic and plastic.

Techniques to Facilitate Micromotion Analysis

Micromotion analysis requires a target having good resolution which remains consistently visible in a field having appropriate calibrated length references, fixed references and a precise time reference. Table I provides representative data for most of the variable factors affecting resolution, i.e., lens, subject distance, aperture setting, camera speed, film emulsion and weather (lighting).

Even when these variable factors are adjusted for optimum resolution consistent with the other requirements for adequate instrumentation, additional improvement in resolution is possible with the application of "painted targets" and "target-lights." The reference markers painted on the side of the car just below the window are examples of painted targets (Fig. 8). Shape and color (contrast of black and white) were selected following an experiment in which many different shapes and color combinations were applied to an experimental vehicle and evaluated by high-speed photography under actual collision conditions.

The development of target-lights was an innovation of the Institute for the purpose of providing an intensely concentrated light-source in an otherwise poorly illuminated area. By rigidly securing a small, fixed-filament, 3-v, lens-type light bulb to the structure to be studied by high-speed photography, distance-time information became obtainable photographically. Target-lights were applied to the deeper recesses of the engine compartment so that with the car hood removed, a camera mounted in the tower could record the collision performance of the car frame and associated structural components during impact.

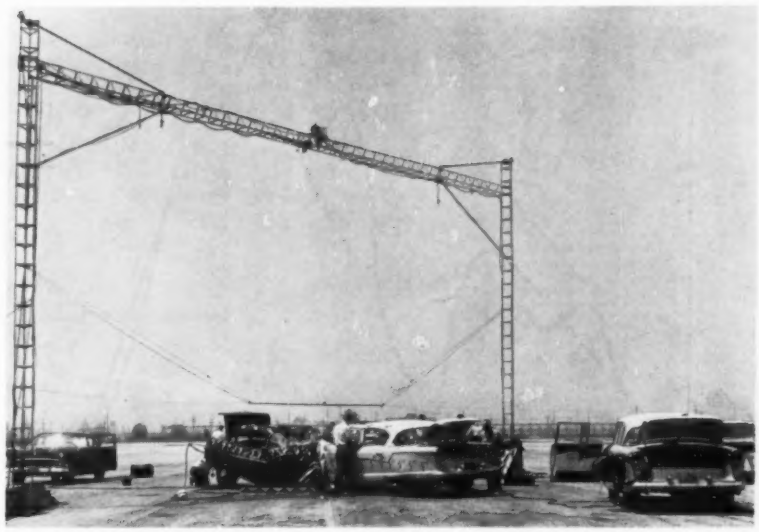


Fig. 9. Data collection continues immediately following collision.

The second requirement for good micromotion analysis is to have the target remain consistently visible during the observation period. This requirement is not always under the control of the researcher. Nonstructural enveloping sections of metal were removed from the automobile to permit continuous observation of the subject or to permit observation from additional camera angles. Occasional conflicts occur despite these precautions. For example, continuity of a photographic sequence may be interrupted by flying debris or the incorrectly anticipated movements of the subject.

Wherever possible, painted target references were applied at calibrated intervals. This permitted a built-in length calibration for the painted targets, such as the targets below the window-line on the sides of the car (Fig. 8) which were located precisely one foot apart starting with zero at the front bumper. During target application, a projector was mounted on a calibrated track to permit projection of target positions at 1-ft increments on the plane of the photograph regardless of the curvature of the car body. These calibrated targets on the sides of the cars served as position reference indices for orientating adjacent structures and were used directly for establishing the relative performance of structural components during collision. They were referred to as station numbers. For example, station 6 was the target positioned precisely 6 ft from the front bumper. Length calibrations located on the car structure were visible from every important camera angle.

The third item affecting micromotion analyses, presence of a fixed reference, is quite important, though easily overlooked. Frame-by-frame measurements made on 16mm film covering a collision event must be made relative to some fixed reference having good resolution. On an optical comparator the cross hairs are placed on this reference and the distance between it, read to an accuracy of 1/10,000 in., and any particular target is determined for successive frames. When a high-speed camera is brought so close to the collision event that surrounding stationary references are excluded from view, then provisions must be made to superimpose a fixed reference across the field of view. The calibrated fixed reference suspended directly above the crashing vehicles provided the high-speed vertical camera with a fixed reference in an otherwise totally dynamic field. These fixed references may be seen by referring again to Figs. 5 and 8. The coordinates painted on the runway at the impact point are directly below the cameras mounted in the tower (Fig. 5). These fixed references facilitate determination of rotational velocity and acceleration associated with the "Spin" the vehicle receives from an eccentric impact. A second motion-picture camera with a wide-angle lens was mounted in the tower to record this information.

Data acceptable for micromotion analysis must have adequate timing. Two timing devices placed within photographic view of the camera were tried; one a strobe-light, the other a centisecond electric clock. Interpretation difficulties led to the use of cameras having built-in timing lights. Three systems for firing these argon lamps were tried. Line voltage (60 cycles/sec), a 60-, 120-, 240-cycle crystal-controlled pulse-generator designed for field operations where line voltage was unobtainable and, more recently, a centisecond/-

§Derwyn Severy and Paul Barbour, "Acceleration accuracy: analyses of high-speed camera film," *Jour. SMPTE, 65:* 96–99, Feb. 1956.

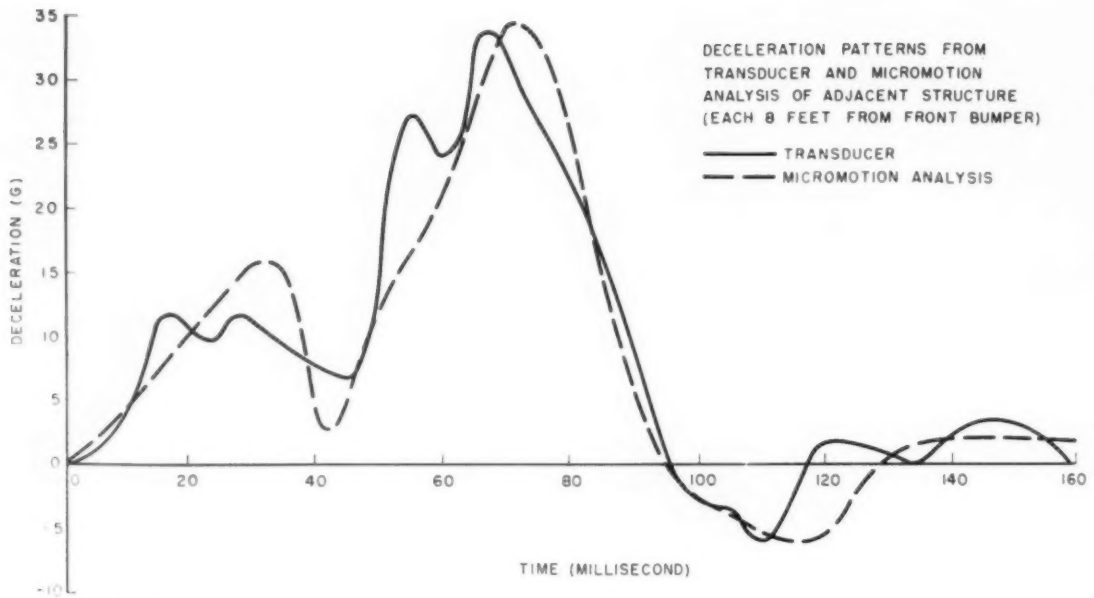


Fig. 10. Barrier collision.

millisecond pulse generator manufactured by Wollensak Optical Co. This latter device has the advantage of permitting distance measurements for a given film frame to be related directly to the number of milliseconds after zero time. The zero millisecond reference denotes that film frame representing the instant of vehicle contact with an opposing structure.

Camera-Oscillograph Synchronization and Timing

A technique was developed for providing a common time reference for high-speed photography and oscillographic recording of collision data. The start of physical contact between the two crash cars closes an electrical circuit which energizes a flashbulb mounted near the radiator of car No. 2. A photoelectric cell mounted in a comparable position on car No. 1 was shielded to receive light only from the direction of the flashbulb mounted on car No. 2. The electrical pulse from the photocell was fed to one of the channels of the oscilloscope. The first frame of high-speed motion-picture film showing a bright flash on the hood of car No. 2 and the corresponding signal on the oscillographic record provide a synchronized "zero time." Precise synchronization was obtained by appropriate selection of the type of flashbulb and photocell used as well as the distance the electrical switch extended in front of the car bumper.

Photographic vs. Electrical Instrumentation

As stated earlier, impact phenomena as complicated as the automobile collision presents a difficult instrumentation task. Until recently, the performances of transducer sensing devices designed to provide acceleration data were so poor under collision conditions that only limited use could be made of the data derived by this means. On the other hand, precise control must be exercised over both the graphical and analytical differentiation processes of distance-time data derived from frame-by-frame analyses of high-speed motion-picture film to avoid errors from this method of instrumentation of an order of magnitude comparable to the earlier transducers. Consequently, for instrumentation control purposes as well as to reduce the possibilities of loss of primary data from failure by a single instrumentation recording system during collision, both photographic and electrical-transducer instru-



Fig. 11. Impact forces rear seat occupant's head forward and downward.

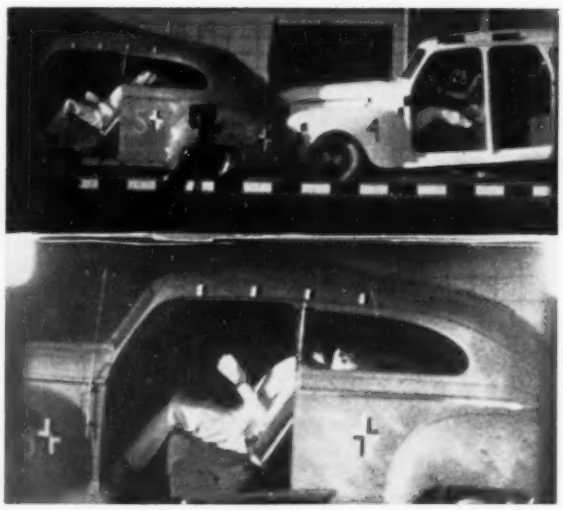


Fig. 12. Rear-end collision at 20 mph.

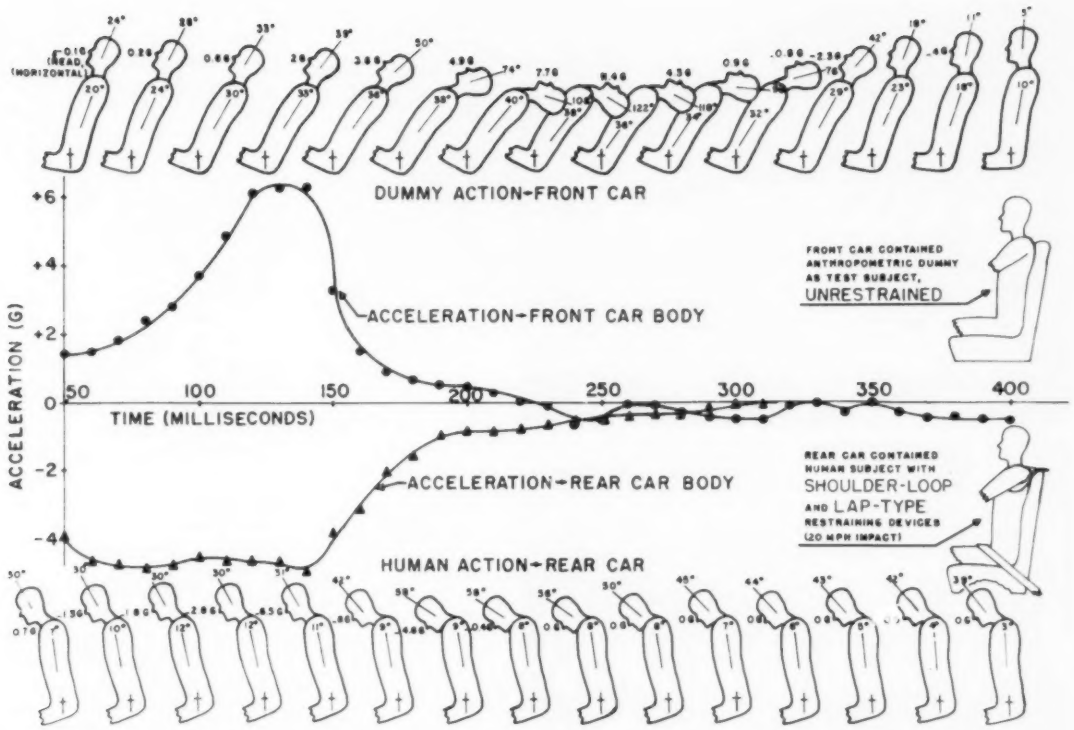


Fig. 13. Kinematic analyses made possible by micromotion analyses of high-speed motion-picture film.

mentation are applied as extensively as economically feasible and with sufficient overlapping of the two systems to permit correlations to be made. An example of correlation between the photographic and electrical instrumentation systems operating under impact conditions is shown in Fig. 10.

Exclusive Application of Photographic Instrumentation

Two conditions limit the application of electrical transducers to collision research: (1) monitoring structures undergoing extreme destructive collapse and (2) monitoring structures undergoing axis rotation preceding and during the significant deceleration event. Transducers to be mounted near collapsing structures are encased in a rigid steel box. Even with this precaution the box may be bent, the electrical lead severed, punctured, or the entire box torn loose if it is situated too close to the grossly collapsing structure. During the preparation period for the first 50-mph head-on collision experiment, a last-minute decision was made to move the most forward transducer at station 3.5 ($3\frac{1}{2}$ ft from front bumper) even farther back to station 5. Some damage to the transducer resulted, despite this more remote position; nevertheless, acceptable photographic data may frequently be obtained under these adverse conditions.

For purposes of providing reliable data, transducers measuring linear acceleration are designed with essentially no cross-axis sensitivity. The significance of this statement should become clearer with the following example: a transducer is mounted in the head of an anthropometric dummy rear-seat passenger restrained by a lap belt. The car strikes a fixed object and during the collision, the dummy's head is forced along the vertical arc of forward and downward travel (Fig. 11).[‖] The sensitive axis of the transducer is no longer recording the desired longitudinal deceleration but rather the rotational deceleration nearly 90° to the longitudinal. The significance of readings of this nature is difficult to establish. Micromotion analysis of the head referenced in Fig. 11 provided data showing that a longitudinal peak deceleration of 38 G was reached during the impact.

Kinematic Analysis

During a collision event, instrumentation using high-speed motion-picture photography is most effectively utilized for kinematic analysis of the motorist and his vehicle. For example, ten feet of high-speed motion-picture film taken by one camera can provide for two colliding cars the following data:

1. velocity and acceleration patterns (cars and drivers),
2. plastic and elastic deformations (cars),
3. postural variations of each motorist during collisions with head and trunk angles specified,
4. precise time reference for the above physical determinations thereby defining the sequence of events.

A single frame from such a sequence is shown as Fig. 12. The analysis of the film provided data typified by Fig. 13.

Mechanism of Structural Failure

Close-up observation of split-second events has long been a recognized application for high-speed photography. It provides an excellent means for studying the mechanism of structural failures during impact. The collision performance of an experimental protective roadside barrier was evaluated by such use of high-speed photography. The observations of one high-speed camera are summarized by the three frames shown in Fig. 14. Lighting and an adequate means for protecting the camera are generally the principal problems in conducting studies of this nature. Camera protection has been accomplished by use of protective barriers of large concrete blocks, a camera pit, and by positioning the camera outside the estimated paths of the colliding vehicles.

Vehicle Deformation

High-speed photography is also being used to measure large deformations that occur during vehicle collision. Micromotion analysis utilizes position-

‖ Research sponsored by the American Motors Corporation.

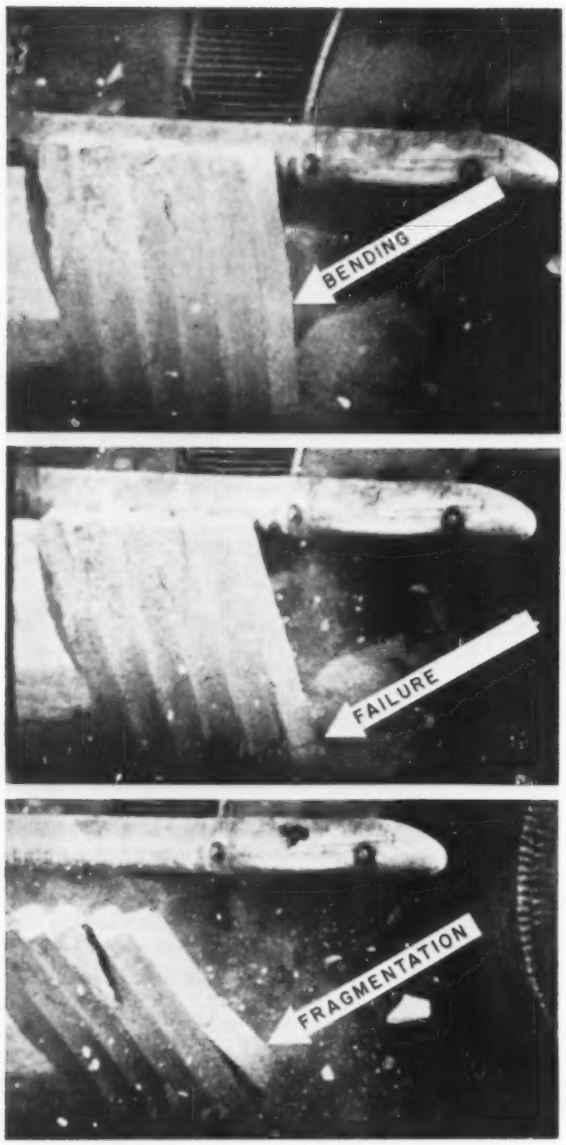


Fig. 14. Collision performance of an experimental roadside protective barrier.

time measurements taken from high-speed motion-picture photography. The total deformation occurring ahead of a point of observation on the car is the distance between the impact surface and the point when initial contact is made with the opposing structure less the closest distance from the point to the structure during the collapse of the automobile. Elastic deformation is this closest distance substracted from the distance the point attains as the car breaks away from the opposing structure as a result of restitution. The inelastic or permanent deformation is the difference between the total and elastic deformation.

As previously stated, it is highly desirable to secure high-speed photographic coverage of the underbody of the vehicle during collision. Several methods have been considered but research funds have not been sufficient to extend instrumentation in this manner. A very effective method has been developed, however, to obtain permanent photographic deformation information for the car underbody. A clear insight into the distribution and extent of collapse is provided by the method of photographic superposition, even though this method lacks the desirable data relating to mechanism of collapse of structures during impact such as would be obtainable by high-speed motion-picture coverage. This still photography method makes use of the identical boundary geometry of the car underbody before and after impact except for those portions deformed by the impact. The superposition of before and after photographic negatives yields a composite photograph which directly portrays the pre-crash and post-crash positions of every part visible from the underside of the car. The inclusion of a 1-ft calibration marker seen at the base of Fig. 15 permits reasonably accurate measurements to be made of underbody displacements whether transverse, longitudinal, or both. This method replaced two rather tedious earlier methods, one involving direct measurement of the frame of the car, the other, measurements made on a photographic negative using an optical comparator. Both of the previous procedures were subsequently plotted graphically or diagrammatically.

Precision Timed Photographs Using a Still Camera

Why Electronic Timing?

The general lack of understanding of the extremely brief duration of automobile collisions is typified by the belief of many photographers that, by manual actuation, they can photograph the planned automobile collision at the instant of maximum structural collapse. If they are not briefed concerning the very short duration of impact they invariably snap a picture late. If briefed, they split between too early and too late reaction. An allowable error of ± 20 msec or $\frac{1}{50}$ sec assures a properly timed photograph. With human reaction time ranging from $\frac{1}{4}$ to $\frac{3}{4}$ sec, chance, rather than skill, determines the possibility of obtaining an acceptable manually actuated photograph. An electronically timed camera using a 4 $\times$ 5 negative can obtain an extremely sharp photograph of the instant of maximum collapse of structures during impact. Obtaining these photographs from several camera angles contributes additional data to the study of the collision.

How to Determine Position of Actuator

The pressure sensitive electric actuator tape used to trigger the electronic time-delay unit must be positioned precisely with respect to both the path of the vehicle's front wheel and the assigned impact center (Figure 16). For example, if a car is moving at 50 mph toward the impact center in a head-on collision with another car, where should actuator tape be placed to secure a zero mph photograph (the time of maximum collapse), if the exact delay for the electronic timer is 184 msec? The problem may be resolved into two parts: the time (T) after passing over the actuator tape which the car takes to reach the place of impact at cruise velocity and the time (T_2) the car requires after contacting the other car to decelerate to zero velocity. The time T is the difference between the

time T_2 and the electronic delay time, T_1. Consequently, the solution resolves itself to the calculation of the collision deceleration time. One may well ask how can the collision deceleration time be calculated for an experiment to be conducted for the first time? Admittedly, this calculation is only as good as the estimate of the maximum collapse distance that will occur for the given experimental collision. The experience gained in conducting collision research enables one to estimate this time within the ± 20 msec spread for optimum coverage. For velocity of 50 mph, or 73 ft/sec, we use 3.0 ft total collapse distance of one vehicle and $\frac{1}{2}$ of 73 ft/sec as the average collapse velocity.

Let T = Time for car to move X feet, from actuator to impact

T_1 = Delay time for electronic timer = 184 msec

T_2 = Time from contact of cars to zero velocity

$$T = T_1 - T_2 = 184 \text{ msec} - \frac{3 \text{ ft} \times 1000 \text{ msec/sec}}{\frac{1}{2} \times 73 \text{ ft/sec}}$$

$$= 184 \text{ msec} - 82 \text{ msec} = 102 \text{ msec.}$$

Let X = distance the car travels during circuit delay interval

$$= \frac{73 \text{ ft/sec} \times 102 \text{ msec}}{1000 \text{ msec/sec}} = 7.5 \text{ ft.}$$

A correction is necessary to account for the lead the car has toward impact because of the distance the bumper extends in front of the pressure point of the wheel that makes contact with the actuator tape. This measured distance for a 1956 Pontiac, for example, is 2.6 ft which is added to the 7.5 ft to make 10.1 ft.

A second correction is made to change the actuating time of the cameras to 20 msec later than the instant of zero velocity when a study of the secondary impact of the dummy occupants is to be included with the vehicle collision coverage. This 1.5-ft correction is subtracted from the 10.1-ft value to give 8.6 ft, the distance the tape is positioned from impact center.

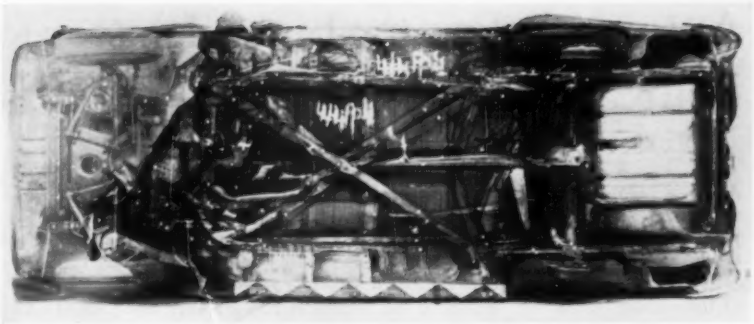


Fig. 15. Photographic superposition provides permanent deformation data for car underbody.

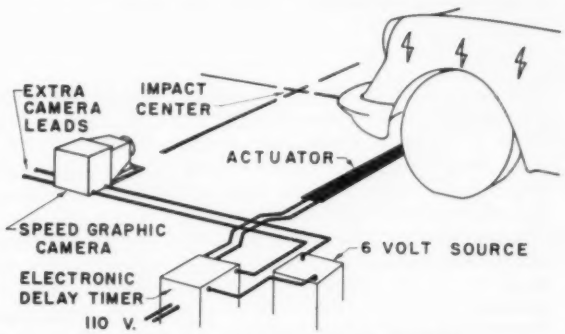


Fig. 16. Equipment for precision timed photographs.

Conclusion

The foregoing explanation of the methods developed to obtain photographically data which can be exactly evaluated illustrates the difficulties inherent in this area of research. The reader may feel that too little attention has been given to the use of electronic instrumentation in these experiments. It is not within the scope of this paper to discuss in detail the electronic instrumentation used to augment photographic instrumentation, but it should be noted that the electronic instrumentation was as carefully selected, developed and utilized as the photographic instrumentation. Following is a brief comparison of the two systems:

Compared with electronic instrumentation, photographic instrumentation requires a smaller investment, lower maintenance costs and approximately the same post-experimental costs for data reduction. Photographic instrumentation requires less pre-experimental preparation time, is more diversified and less subject to malfunction. When the disadvantages of the added time and costs associated with electronic instrumentation can be accommodated by a research project, the value of an independent instrumentation system for purposes of correlation of data, together with the greater diversification of data obtainable, more than justifies the inclusion of electronic instrumentation in the experimental program.

Automatic Printer Light Selector for Bell & Howell Models D and J Printers

By LORAND WARGO, H. M. LITTLE and H. L. BAUMBACH

A device has been designed to set automatically the printer light selection lever on the Models D and J Bell & Howell printers. Punched paper tape containing the printer light sequence is prepared on a Keyboard-Perforator. This paper tape is fed into a tape reader. The electrical signals produced in the reader are then decoded by a computer unit which in turn directs a servo unit in its manipulation of the printer lever. The action of the device is considerably more rapid and accurate than manual performance and it can, of course, operate in total darkness. The robot unit is easily installed on the printing machine and it demands no mechanical alteration of the printing equipment.

Normal operation of the Model D Bell & Howell continuous printer for 35mm films and the Model J printer for 16mm films requires the manual setting of the printer light selection lever for each negative scene of different exposure. Exposures are programmed on a single preselected basis and a change is produced by an electrical pulse timed by a notch, electrically conducting patch, magnetic dab or even a separate cue roll. When the electrical pulse occurs, the light modulation shutter is quickly released to its preselected position, whereupon the operator must select the next light value in advance of the next notch.

Since film printing on this equipment must be performed under darkroom safelight conditions, it is often difficult for the operator to be certain that he has made the correct selection, particularly if the printer is running at an appreciably high speed or if the negative scenes are very short.

The automatic device described in this paper is designed specifically to perform this manual operation much more quickly and accurately than is humanly possible and, of course, even in total darkness should this be required.

Punched paper tape pre-records the desired light intensity values in the proper sequence to print a given roll of negative. The exposure information is encoded into the five-hole system described in an earlier paper.* The five holes across the tape make it possible to obtain 32 different values of light intensity, but since 30 are ample (the normal Bell & Howell dial uses only 21), the no-hole condition is used for automatic tape advance to the first scene information and the five-hole condition is used to bring the printer drive mechanism to a stop.

The paper tape is fed into a modified tape reader. When the reader switch is activated, the tape automatically pulses to the first scene exposure information wherever it may be on the tape. Upon a notch or electrical pulse from the negative the tape is moved in 10 msec to the next scene information. This process is repeated until the entire roll is printed or until the stop code occurs.

Signals from the tape reader are fed into an electronic computer which can transfer the coded hole information into the individual printer point values in about 10 μsec.

Signals from the computer to the servomechanism tell the device in which direction to move the pointer and the exact position it must stop. Each of these stopping positions is easily adjustable with a screwdriver, so that there is no difficulty matching any dial number position. Frequently the normal 21 printer points are not of sufficient range for all types of intercut negatives and the user may want to raise the overall printer exposure range to take advantage of the 30 values available.

The tape reader and the computer may be mounted on any convenient bench or desk close to the printer. Cables lead to the servo unit which is mounted directly on the dial of the printer. During the mounting, the level retaining pin is held in withdrawn position by the servo linkage. The printer light lever remains on the printer and indicates its position at all times. No mechanical changes to the printer are involved.

This paper was presented on October 4, 1957, at the Society's Convention at Philadelphia by J. W. Stafford for the authors, Lorand Wargo, H. M. Little and H. L. Baumbach, Unicorn Engineering Corp., 1040 N. McCadden Pl., Hollywood 38.
(This paper was received on October 3, 1957.)

* H. M. Little and H. L. Baumbach, "Automatic printer operation from punched tape and punched cards," *Jour. SMPTE, 66:* 550–551, Sept. 1957.

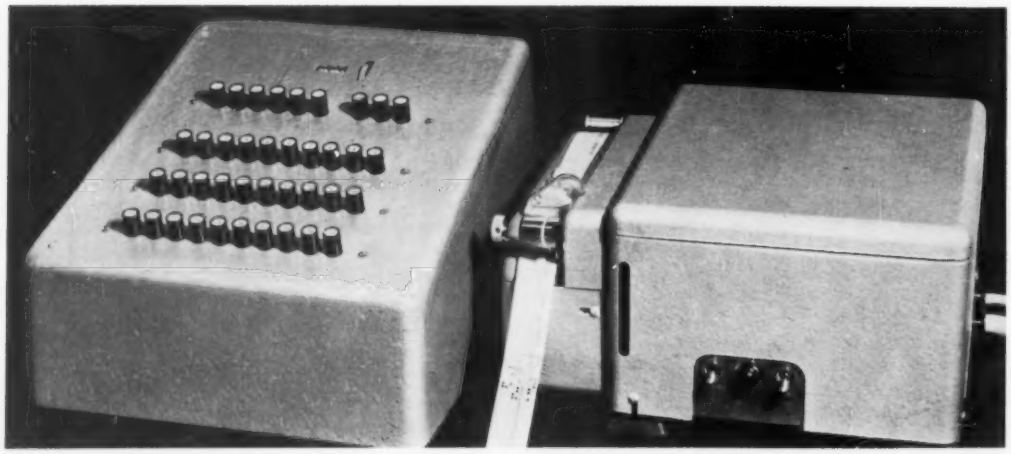


Fig. 1. Keyboard-Perforator.

The Tape Code

Punched paper tapes are prepared on the Keyboard-Perforator (Fig. 1). For light-intensity control purposes only five holes are needed in the tape in order to satisfy the 30 different values. The code system is based upon adding holes with printer point values of 1, 2, 4, 8 and 16 in the proper combination to produce the desired printer light. Thus light 15 is the sum of holes with values of 1, 2, 4, and 8.

The Tape Reader

The punched paper tape is fed into a tape reader which has been modified to bring about the sequential analysis of one row of holes for each electrical pulse originating at the film negative. The punched information present in the tape code then produces a set of electrical information which persists for the duration of the film scene. The operation of the tape reader is very rapid. Successive rows of punched holes can be read at the rate of 1100 per min, while the time lapse from one set of electrical data to the other is only 10 msec.

These readers show excellent performance characteristics. Designed as they are for continuously pulsed operation in their application in automatic typing, the much less extensive use of film printing extends their mechanical life considerably. Errors in the mechanical-to-electrical transfer have been nonexistent in this design. Electrical contacts are made within the reader on a dual basis, thereby minimizing the chances for error due to dirt.

The information present in the paper tape is transferred by the reader, without decoding, into electrical information which is then fed into the computer.

The Computer-Decoding Section

The computer is an electronic device incorporating relays, vacuum tubes and other typical components which can accept the coded electrical signals from the tape reader and convert each combination into its separate function.

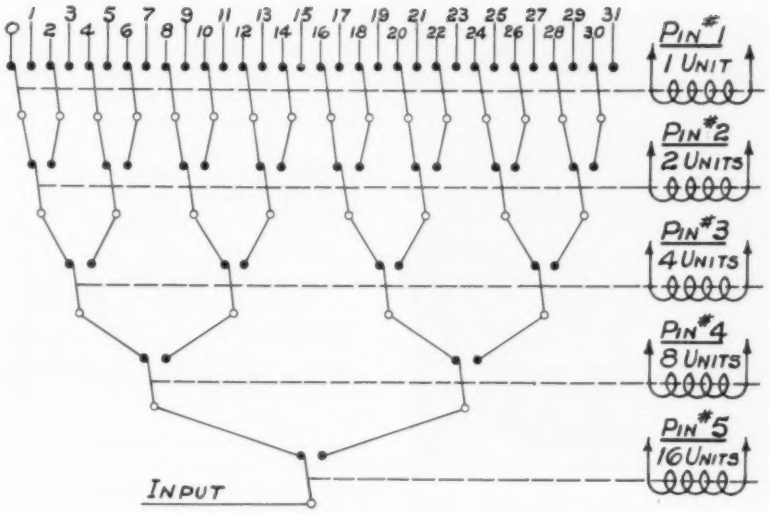


Fig. 2. Five-stage, 32-channel network.

The five bits of electrical information are separated into 32 discrete electrical values by means of a 5-stage, 32-channel network (Fig. 2).

When, for example, there are no holes in the paper tape and therefore no electrical signals from the reader, none of the relays operates. The network is set for channel 0 and the reader input is connected through all five stages to terminal 0. This condition is used for repeated tape advance until at least one channel is opened by the presence of an electrical signal. In this manner, the tape reader is caused to pulse continuously until the first punched information is present in the tape

Similarly if electrical signals are fed from all five holes in the tape, five stages in the relay network become activated to terminal 31 which in turn actuates a power relay connected with the printer drive motor, thereby causing the printing machine to stop automatically.

Any other terminal between 0 and 31 may be connected to the input terminal by energizing the corresponding relays from the holes in the coded tape. Thus connection of the input to terminal 9 requires holes in the tape corresponding to relays in line 1 and 4 equivalent to 1 and 8 printer light units. Pins 1 and 4, actuating solenoids 1 and 4, lead the connection through five stages from the input terminal through channel 9 to contact 9.

The Computer-Comparator Section

It is important that the printer light selector lever be moved as quickly as possible to the new printing light value of the next negative scene. When a printer operator is performing this function, he will observe whether the new value is higher or lower than the old and move the lever in the correct direction. Likewise the computer is de-

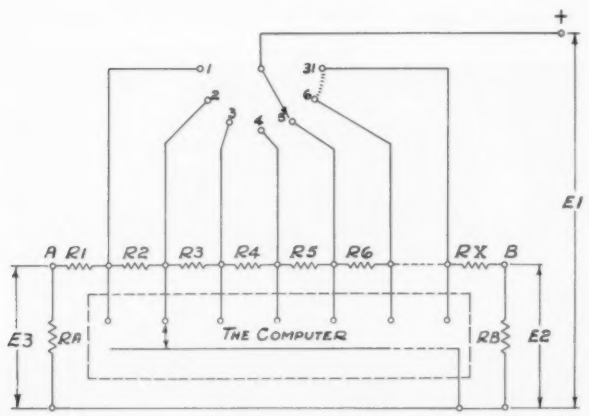


Fig. 3. The four-point resistive network of the computer.

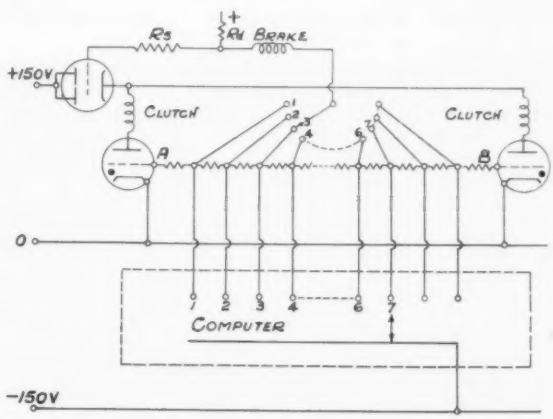


Fig. 4. Magnetic clutch circuit schematic.

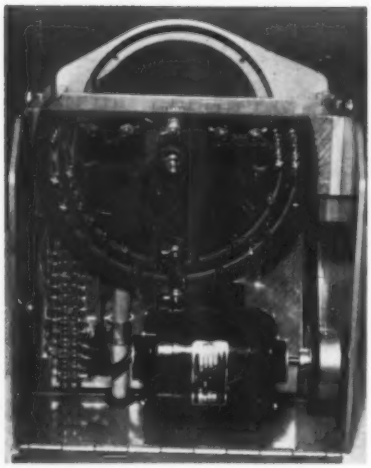


Fig. 5. Inside servomechanism.

signed to make this same decision so that time will not be lost seeking the correct new position.

The computer contains a section which compares the new printing light value with the old position across the four point resistive network shown in Fig. 3. To illustrate this circuit, let us suppose that the computed tape information selected contact 2 as the desired new arm position and that its present position is at contact 5. The flow of current will be from contact 5 through resistors R5–R4–R3 through the computer to ground potential. Since R_a and R_b have values which are approximately infinite, E_1 is approximately equal to E_2 and E_3 to 0 (the internal resistance of the computer being 0). Under this condition, point B carries a positive potential and point A a zero potential.

Similarly, if the arm is at contact 3, and 6 is the new selection, point B will be at zero potential and point A will carry a positive potential.

It is evident that this circuit is able to deliver a positive signal either to point A or point B by comparing the momentary position of the selector arm with the future position dictated by the tape. Through the use of a thyratron tube in the circuit of each clutch of the servomechanism, we are able to energize the proper clutch and to bring about the correct direction of rotation.

The possibility that both clutches might become energized simultaneously is prevented by the use of two relays with their normally closed contacts in parallel but in series with the B+ supply. The coil of each relay is connected with the plate circuit of a thyratron, thus there is no B+ supply to the clutches if both relays operate.

Reference to the circuit of Fig. 4 shows that the energizing of the proper clutch by the signal delivered to the grid of the thyratron will cause the engagement of the proper motor drive and bring about movement of the selector arm in the proper direction. In order that the arm may be stopped at the precise moment when it has reached the preselected contact, a magnetic brake is added in series with the lead to the resistive network in the comparator circuit. Returning the input to a negative polarized source instead of ground at zero potential gives the advantage of producing negative potential on the inactive thyratron, thereby preventing misfiring because of any parasitic transient pulse on the resistive network.

In order that the magnetic clutch may be disconnected when the correct contact point is reached and the brake applied, a power tube is inserted in series with the B supply of the clutches and a resistive coupling is provided from the contact arm to the grid of this tube. Before the arm begins to travel it will always carry a positive potential; the power tube will therefore conduct and voltage is available at the clutches. As soon as the arm reaches the preselected contact, potential becomes negative, the power tube is driven to cutoff, and the clutch is disengaged. At the same time, current starts to flow through the magnetic brake, thereby preventing further movement.

If, by any chance, the contact arm stops between two contacts, such as would be the case with a power failure or a blown fuse, a single pulse generator is provided within the chassis to fire one of the thyratrons. This pulse generator is normally inactive and is engaged only in the absence of other signals.

The Servomechanism

The servomechanism consists of an arm which locks onto the printer selection lever and a housing containing two electric motors, two magnetic clutches, a magnetic brake and the adjustable contact positions. The inside of this unit is shown in Fig. 5. The two motors operate continuously in opposite directions and rotation of the shaft which moves the pointer depends upon which of the magnetic clutches is being energized.

The worm gearing from the drive motors supplies ample power to move the selector arm against the strong spring action contained within the Bell & Howell shutter mechanism. Because the clutches and brake are located on the high-speed side of this gearing, their action is rapid and powerful in terms of the output shaft.

The entire servomechanism is designed to "butt on" onto the Bell & Howell printer light selector dial. The device hangs from this dial and locks in position without requiring mechanical modification of the printer. The numbers on the dial can be seen over the top of the servo unit, thus facilitating the initial setting of the printer point position. Any portion or all of the available printer point values may be utilized and the remaining ones shorted together.

Conclusions

Use of this printer robot in film laboratories has yielded very favorable results. Printing errors have been reduced and film printing production increased.

Negatives which would ordinarily require printing on very slow equipment because of a large number of short scenes have been printed on production printers. In particular, 16mm printing has been greatly aided as the result of the rapid action of the device.

Multiple prints are easily produced since the same paper tape may be placed in the reader as many times as desired.

Discussion

Findlay J. Quinn (Trans-World Labs.): Has there been any attempt to combine the use of the feed device in this device to actuate the fade shutter?

Mr. Stafford: Actually, not with the Bell & Howell continuous printer; however, we are working on such a device. Fade devices have been worked out for General Film Laboratories on step printers and other types of printing equipment but, as yet, we do not have a system available for the Bell & Howell continuous printer.

A New Color Timer for Motion-Picture Films

By J. W. STAFFORD
and H. L. BAUMBACH

A new device has been developed for the determination of the correct printing exposures for color films. The device accepts a density range test as exposed under the negative scene with average standard exposure conditions. The viewing field under the test positive may be varied in hue to the desired color balance while a condition of constant brightness is automatically maintained. A built-in analog computer calculates the corrections from the standard condition in terms of red, green and blue light for additive printing and cyan, magenta and yellow light for subtractive printing. The variable hue viewing field is surrounded by standard photometric fields to maintain constant eye adaptation. The system enables the color timer to specify correct printing conditions directly from the single test series. In most cases, a fully corrected print is produced directly from the color timing.

An important aspect of laboratory procedures in motion-picture printing is the determination of correct exposure values. The final release print must run continuously with its scene changes, fades, cuts from long shots to close-ups, effects, etc., and give an impression of normal lighting conditions with no unnatural changes of illumination. The most desirable printing exposure is determined more by artistic values than by any definitely measurable characteristics of negative or print, thus precluding any quantitative analytical solution. Selection of printing values must depend on the judgment of an individual — essentially an artist with an innate feeling of correct illumination balance.

Timing, although critical, has not been too much of a problem in black-and-white work as the main condition to be satisfied is a print density that will give the desired brightness. On the other hand, in color printing, overall intensity, as well as relative intensities of the red, green and blue components of the printing light, must be satisfied simultaneously. It is this multiplicity of necessary exposure conditions that makes the timing of color prints difficult.

There are two methods currently used for controlling relative red, green and blue intensities in color printing. In the additive method, the exposing light is composed of the three separately controlled components, red, green and blue. The subtractive method consists of controlling the relative red, green and blue intensities by the use of cyan, magenta and yellow color compensating filters, or, as the name suggests, subtracting components from a standard light distribution to obtain the particular required color balance.

There are several possible systems by which exposure conditions can be determined. The simple method of successive trials and direct viewing under standard projection conditions seems to be the most prevalent, and, in the final analysis, is the only system used. The different methods simply attempt to determine printing constants in such a manner as to minimize the number of successive trials as well as time involved in obtaining a satisfactory print.

If, with each negative to be printed, a gray scale chart has been photographed under the same lighting conditions as the actual scene, densitometric analysis of the chart areas in the negative should furnish sufficient data for the computation of approximate printing conditions.

If, for each scene to be printed, an analysis is made of the integrated frame density in terms of its red, green and blue values, data are obtained which, based on statistical averages, can be used for computing printing constants that on the average should yield a satisfactory print.

A rather complex color television scan method is also being used. The negative to be printed is scanned, the negative image converted to positive and presented to an observer through a color television system. The system is designed so that the operator can make electrical adjustments to produce the desired picture image. Printing constants are then computed using the functional relationship between negative characteristics and electrical control required to produce the desired picture image.

The method of making sample prints of a given negative using the various possible exposure combinations is also used. The system, sometimes called "ring around" sampling, can become quite cumbersome, particularly if all the combinations of the four variables are included.

If a film viewer is made in such a manner that the red, green and blue color balance can be controlled by an observer while the total illumination remains constant, printer samples of constant average color balance but of varying exposure can be examined and printer light as well as necessary color corrections can be determined. Such a system implies the assumption that

Presented on October 4, 1957, at the Society's Convention at Philadelphia by J. W. Stafford (who read the paper) and H. L. Baumbach, Unicorn Engineering Corp., 1040 N. McCadden Pl., Hollywood 38.

(This paper was received on October 3, 1957.)

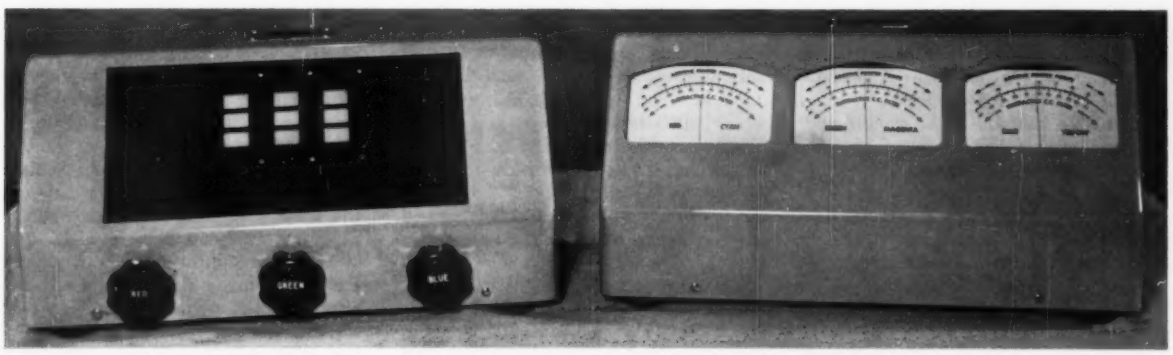


Fig. 1. Complete color timer.

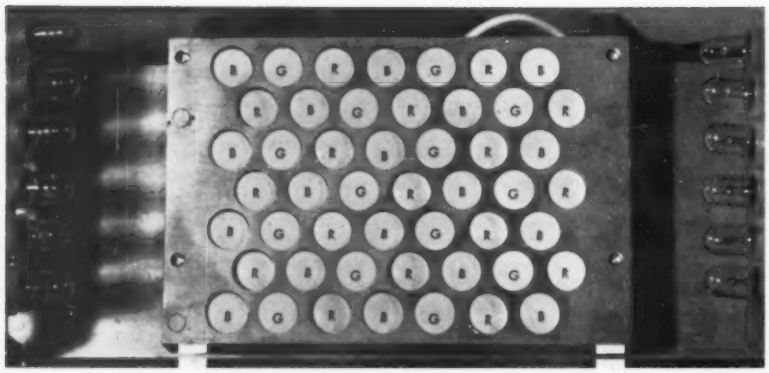


Fig. 2. Photometric field arrangement.

change in color balance of viewing illumination is approximately equivalent to change in color balance of print being viewed. Experience has shown this to be true for quite a usable range of color balance, particularly if the observer makes certain reservations for appearance of highlights.

The instrument described in this paper applies this last method of sampling.

Design of System

It is well known that color perception depends not only on actual color of an object being observed, but also on color conditions of the surroundings. It is therefore apparent that any viewing method employing a light field of varying color balance must also have some sort of reference surrounding condition by which color perception will be held at a constant value. As shown in Fig. 1, the photometric viewing field is, therefore, composed of standard fixed sections on either side of a variable color section of equal intensity.

The variable field is produced by three series of small incandescent lamps — red, green and blue — in such an array that lamps of like color are not adjacent. The three series are controlled by interlocking rheostats so that total illumination is essentially unaltered by a change in color balance.

This feature of constant total illumination with changing color balance is introduced so that the observer's judgment of overall intensity will not be influenced by the particular color balance required for a given scene.

The color is produced by ground and polished glass filters in front of each lamp. The colored light is then integrated by a piece of ground glass and a piece of opal glass to form the viewing field. The standard comparison field is formed by a series of lamps, filtered in this particular case to the quality of a projection arc, the light from which is integrated as above.

Preliminary measurements indicated that sufficient illumination could be obtained from an array of small 0.25-amp ratio dial lamps. At a distance of about two inches, using the necessary diffusion for proper integration, an illumination of 20 ft-c was obtained at somewhat below rated voltage on the lamps. As the rated life of these lamps is 3,000 hr, such an array should be ideal for illuminating the viewing field.

Figure 2 shows the arrangement of the red, green and blue series of lamps. Holes through a $\frac{3}{4}$-in. aluminum plate, counterbored on one side to hold the color filters, serve to confine the light from each individual lamp to its corresponding filter. Corning colored glass filters — Red No. 2418, Green Nos. 4015 and 9780, and Blue No. 5543 — are ground and polished to the thicknesses that give the desired transmission curves (Fig. 3). In the case of green, two filters are needed to achieve the desired curve. The blue-green glass No. 9780 is used to trim the excessive residual red transmission of the No. 4015 green.

A No. 5900 Corning color temperature correcting filter, ground on one surface and polished on the other, serves to simulate arc projection quality as well as to integrate the light for the reference field.

In order to maintain constant intensity with changing hue of the variable field, each of the control rheostats — red, green and blue — has three sections. The red control, for example, has a 150-ohm rheostat and two 75-ohm rheostats on a common shaft so that all three change by the same angular amount. The 150-ohm rheostat is in series with the red lamps, one of the 75-ohm rheostats is in series with the green lamps, and the remaining 75-ohm rheostat is in series with the blue lamps. Each of the 75-ohm rheostats is phased electrically so that for a given change in the 150-ohm rheostat half as much takes place in each of the smaller ones, but in the opposite direction. Therefore, for a given increase in red light, both the green and blue will decrease half as much so that total illumination will remain essentially constant. The green and the blue controls, of course, operate in a similar manner.

Such an interlocking of the red, green and blue controls holds the total intensity essentially constant as the hue is varied. The three variables, however, are obviously not all independent and, therefore, there is not a unique angular position for a given hue. For example, if all three controls are rotated through the same angle in the same direction, the hue remains unchanged. However, for a given hue, there is a unique set of readings even though this multiplicity of angular positions exists.

Having the photometric field conditions, with necessary hue controls established, a computation and presentation method is needed to complete the system. A meter in each of the three series, calibrated directly in terms of printing corrections, is the obvious answer.

A direct-current 0–1.0 milliammeter with meter rectifier and a variable 50,000-ohm series resistor is connected across each of the total variable resistances of the red, green and blue lights. The voltage drop across the rheostats rather than across the lamps directly is used as a matter of convenience. Increasing a particular light will decrease the corresponding meter reading which happens to be the required direction of the necessary printer correction. The meters each have two scales: one reading printer points to be added or subtracted, the other in terms of color compensating filters to be added or removed from a standard basic filter pack. Printer points are in terms of 0.03 log steps while filters are in 0.05 density steps, neutral density values not included.

With the components used, full-scale deflection of the meters was not obtained; and furthermore, the amount of deflection varied with the different colors. By suppressing the zero settings of the meters and adjusting the series resistors, it is possible to adjust the three meters to full-scale total deflection for the usable range. For the sake of ease in reading the meters, this method of zero suppression is used.

The system was calibrated empirically. The reference or surround field was set at 20 ft-c with an exposure meter type illuminometer and the variable field balanced to it as carefully as possible using the red, green and blue powerstats, the control rheostats being in their center position. After attaining balance, the meters were set to center scale by adjusting their dividohm resistors.

As a first approximation, temporary scales were made by the use of a Densichron, measuring increments of 0.072 log changes for each color series with the other two turned off. The 0.072 was used on the assumption of a color

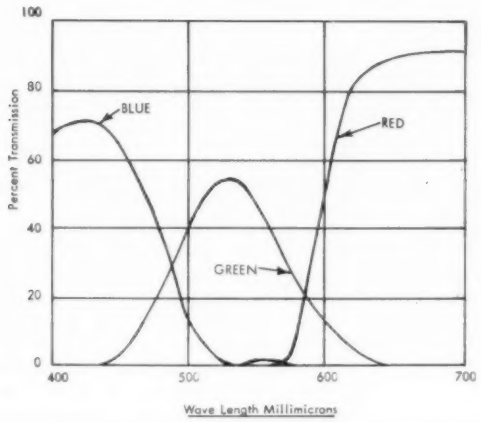


Fig. 3. Spectrophotometric curves of glass filters: red, Corning No. 2418; green, Nos. 4015 and 9780; blue, No. 5543.

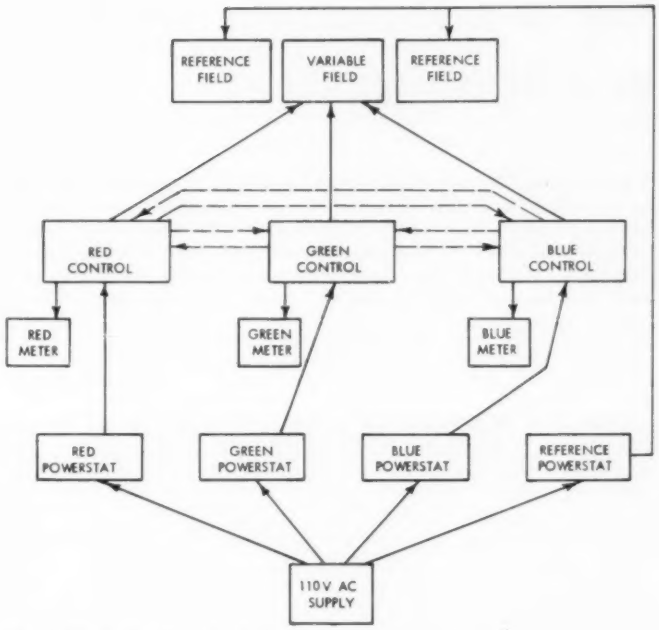


Fig. 4. Block diagram of color timer system.

positive gamma of 2.4 and a printer increment of a 0.03 log step.

A statistical study was next made using a variety of color negatives printed at the various possible color balance conditions used in printing. In each case, these tests were balanced in the variable field of the viewer against a standard scene in the reference field.

From the above data an average correlation of readings versus known color balance change was used as a correction factor for a second approximation. The same series of tests measured under the conditions of these corrected scales indicated a satisfactory correlation.

A third and final adjusted set of scales was therefore made utilizing a suppressed zero system. Further slight corrections from the second approximation were also added. As a result, the red, green and blue scales are not only identical but reasonably uniformly spaced.

Figure 4 is a block diagram of the entire system.

Use in Laboratories

Several applications to color laboratory procedures involving adjustment of color balance of prints, internegatives, master positives, etc., in addition to the main design feature of timing color negatives, are possible.

To time negatives, tests are made in a printer or other scene testing device using the total intensity range at a known constant color balance. The color conditions that fit the average negative should be used in order to minimize for a particular case the amount of color correction required for a satisfactory print. These tests are observed over the variable viewing field and, first, correct printer light is chosen for the best overall density; then the desirable color balance is determined by adjusting the red, green and blue controls. The standard light field remains constant during the adjusting operation, thus preventing a change in the observer's color perception.

The standard field can be used merely as a reference white, or samples of correct color balance can be placed over it and the system becomes a scene color comparator with a quantitative measure of red, green and blue component differences.

Conclusion

In any of the laboratory procedures involving visual examination or comparisons of color prints, internegatives, original negative, and master positives, the use of the color timer will aid the observer in making his decision of color balance as well as overall density.

The system has been in use as an aid to the problem of color timing at General Film Laboratories since February 1957. Experience there has shown that, with a little practice in the use of this instrument, an observer will find his selection of the desirable printer constants, i.e., density and color balance, greatly facilitated.

It should be pointed out that the calibration is empirical as well as somewhat arbitrary; therefore, the use of the instrument need not be restricted to any particular process or processing condition.

Use of a Motion-Picture Printer as a Sensitometer

By ROBERT O. GALE
and JOHN J. GRAHAM

A Bell & Howell Printer, Model D, can be used as a sensitometer for exposing process control strips in small laboratories or for emergency work. The variability in exposure of a printer was only slightly greater than that of a commercially used sensitometer, when the instruments were compared under carefully controlled conditions. Procedures are described for the selection and storage of check film stock, printer control, monitoring and control of illumination, and making controlled exposures.

Sensitometers are essential instruments in processing laboratories for making controlled gray-scale exposures, which are used in the continuous evaluation of the process. Several types of sensitometers have been designed to make exposures with a minimum of variability. The cost of these instruments varies from several hundred to several thousand dollars. A laboratory that does not have a sensitometer can use its motion-picture printer, under the proper control conditions, to make exposures for:

1. process control strips
2. control strips for duplication work
3. emulsion comparisons.

The experiment described in this paper compares the reliability of exposures made on a Bell & Howell, Model D, continuous, subtractive printer with exposures made on two sensitometers — an Eastman Intensity Scale Sensitometer, Model 15, and a sensitometer that is in wide commercial use by processing laboratories.

Procedure

The control procedures used in this comparison were similar to the day-to-day and long-range procedures required for sensitometric process evaluation. The procedures include selection and storage of film, control of mechanical characteristics of the printer, monitoring and controlling the illumination, and exposure.

Film and Exposure

Eastman Color Print Film, Type 5382, from one emulsion batch, was selected for the control stock. The high contrast of this film makes it a sensitive tool for this comparison, since a small variation in exposure level will produce large density differences.

A carbon step-tablet with a density range from 0 to 3.0, with increments of 0.15, was used with the two sensitometers, and a silver step-tablet was used with the Bell & Howell printer. By splicing the gray scale to film leader, a loop was prepared and used on the Bell & Howell printer at our normal printer speed, which is 60 ft/min. The center of each step of the gray scale was read to minimize any variations in density across the strip. One strip was exposed on each instrument daily for twelve days. Immediately after being exposed, each strip was placed in a keeping room at 0 F until the series was complete. At the end of the twelve-day period, all strips were processed together in a typical Eastman Color Print Film process.

Control limits were established by printing through CC-05 red, green, blue, cyan, magenta and yellow filters on the Bell & Howell printer using the same step-tablet and print film as were used for the comparison of the instruments. The average of the density differences produced by the filter changes was then used as the control limit.

The densities of the processed strips were measured on an Eastman Electronic Densitometer, Type 31A using Status A filters.

The Instruments

The basic setups of the sensitometers and the printer were the same for this comparison. Each instrument had a Pittsburgh 2043 heat-absorbing glass, 4 mm thick, a Kodak Wratten Filter No. 2B, and a Corning 3307 glass filter, which simulates the minimum density of the colored coupler of Eastman Color Negative Film, Type 5248.

Figures 1, 2, and 3 are schematic drawings of the optical systems of the instruments used in this comparison. No attempt was made to match the exposure levels of the three instruments, because it is only necessary that each instrument be uniform within itself.

Printer and Sensitometer Control

The intensity of the lamp in each instrument must be adjusted to, and controlled at, a fixed level by means of current control. Since lamps of only one wattage are used, an ammeter is more satisfactory for long-range control than a voltmeter. A precision ammeter showing nearly full-scale deflection at the required current is necessary for adequate control of lamp current. A precision instrument, such as a Weston D-C Ammeter, Model 901, is satisfactory for this measurement.

Even though the current to the lamp is controlled precisely, there is no assurance that the light output at the film plane will remain constant. The output will change with: lamp aging, dirt collected on the optical elements, change in alignment of the optical elements and filter fading. Consequently, the actual intensity and spectral quality of the light at the film plane must be checked as a precautionary control measure.

In this experiment the intensity of the lamp of each of the two sensitometers was monitored weekly with a photoelectric cell connected to a precision microammeter, such as Model 622

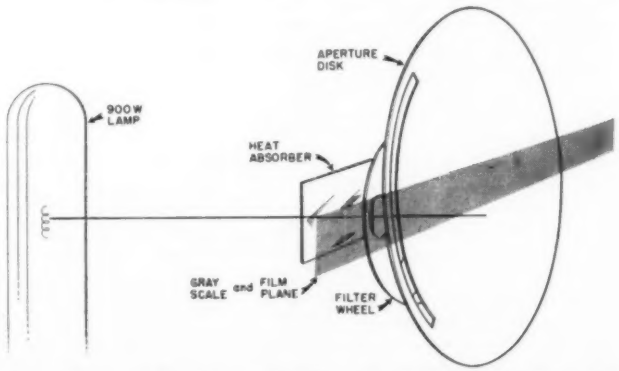


Fig. 1. Schematic of the optical path of the Eastman Intensity-Scale Sensitometer, Model 15.

Presented on October 3, 1957, at the Society's Convention at Philadelphia by Robert O. Gale and John J. Graham (who read the paper), Color Technology Div., Eastman Kodak Co., Kodak Park Works, Rochester 4, N. Y.

(This paper was received on December 9, 1957.)

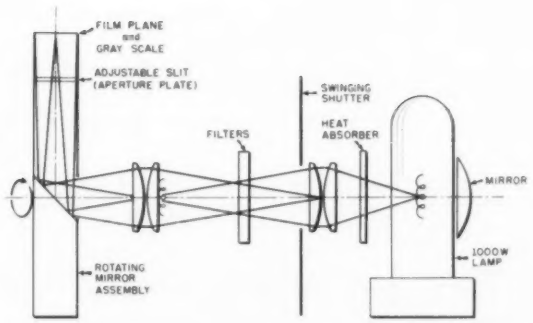


Fig. 2. Schematic of the optical path of the commercial sensitometer used in the tests.

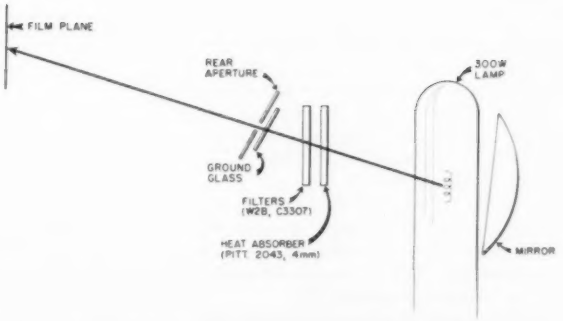


Fig. 3. Schematic of the optical path of the Bell & Howell Motion Picture Printer, Model D, as used in these tests.

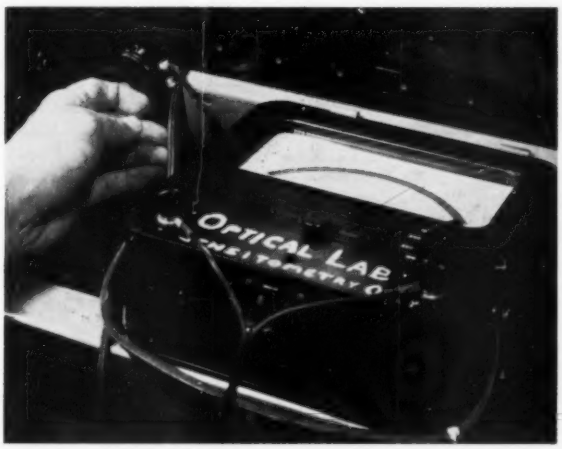


Fig. 4. Photoelectric probe in place for monitoring the light intensity on Eastman Intensity-Scale Sensitometer, Model 15.

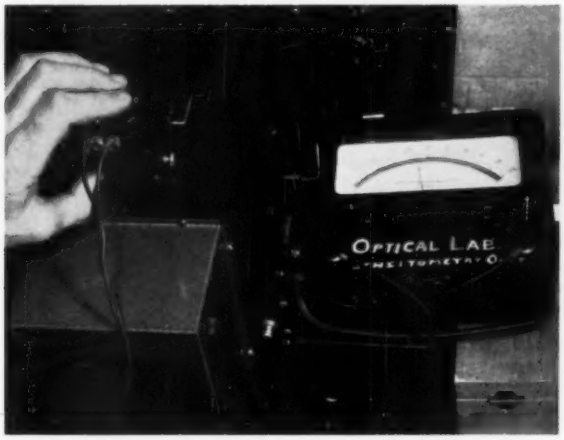


Fig. 5. Photoelectric probe in place for monitoring the light intensity on the commercial sensitometer.

manufactured by the Weston Electrical Instrument Co. (range 0–50 μa). In using a photoelectric probe of this kind it is essential that the probe be positioned on each instrument in a precisely reproducible manner. The check of the illumination will be unreliable if errors are made in positioning the probe in making day-to-day and week-to-week measurements. Figures 4 and 5 show the photoelectric cell in place on each of the sensitometers.

The intensity of the Bell & Howell printer was monitored daily with the photoelectric probe described by Sant, Goddard, and Miller,* using the Weston Model 622 microammeter. Figure 6 shows the probe positioned in front of the printer aperture after the film-gate shoe is removed. Mounting the probe on the shoe-positioning shaft insures that it is reproducibly positioned. The spectral quality of the light was measured through the tricolor filters with only the Wratten No. 2B and the Pittsburgh 2043

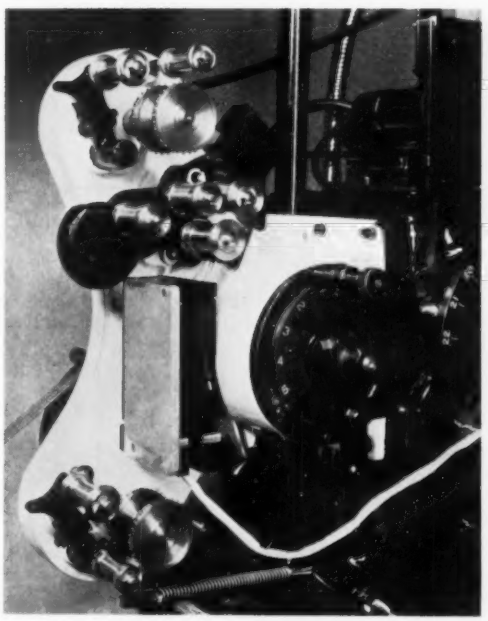


Fig. 6. Photoelectric probe in place for monitoring the light intensity on the Bell & Howell Motion Picture Printer, Model D.

* A. J. Sant, M. C. Goddard and O. E. Miller, "A light meter for printer control," *Jour. SMPTE 64:* 123–125, Mar. 1955.

heat-absorber in the beam. This measurement enables the operator to adjust lamp current to compensate for lamp aging. On the printer, intensity and spectral quality were measured immediately before each exposure in addition to the routine daily checks.

As a quick check on the uniformity of the sprocket drive, a monthly measurement is made of the motion of the film-gate sprocket with a Strobotac, manufactured by General Radio Co.

The uniformity of illumination at the exposure plane of the printer is checked monthly by flashing Eastman Color Print Film to a neutral density of 1.00. The densities of the processed film are measured at several points across the exposed area on an Eastman Electronic Densitometer, Type 31A. The flashed film can be used for checking uniformity of drive as well, if a Strobotac is not available.

Results

The densities of the strips obtained by daily exposure over the twelve-day period are plotted in Fig. 7 for each of the three instruments. These charts show that the exposure variability of the Bell & Howell Printer, Model D, is only slightly greater than that of the commercial sensitometer. For the printer this variability is only about half that produced by a CC-05 filter change.

Conclusions

A motion-picture printer, properly controlled, can be substituted for a sensitometer in emergencies, or it can be used by small laboratories as a means of obtaining adequate sensitometric exposures for process evaluation. The method discussed also can be useful for printer control. The method depends for its success on observing certain precautions in the procedures to be followed. For this reason the following check list is provided as a guide:

(1) Select an adequate supply of control film stock.

(2) Store control film at approximately 0 F.

(3) Select step-tablet and make printer loop.

(4) Store step-tablet printer loop so as to prevent dirt and scratches.

(5) Check uniformity of the film-gate sprocket once a month with a Strobotac with film in operating position.

(6) Check uniformity of the film plane with a photographic flash test.

When sensitometric exposures are to be made:

(1) Remove control film from cold room and bring to room temperature before printing (note film manufacturer's recommendation).

(2) Check the intensity and spectral quality of the light source with a photoelectric probe.

(3) Check printer lamp current, filters, aperture opening, printer speed.

(4) Thread printer and make exposures.

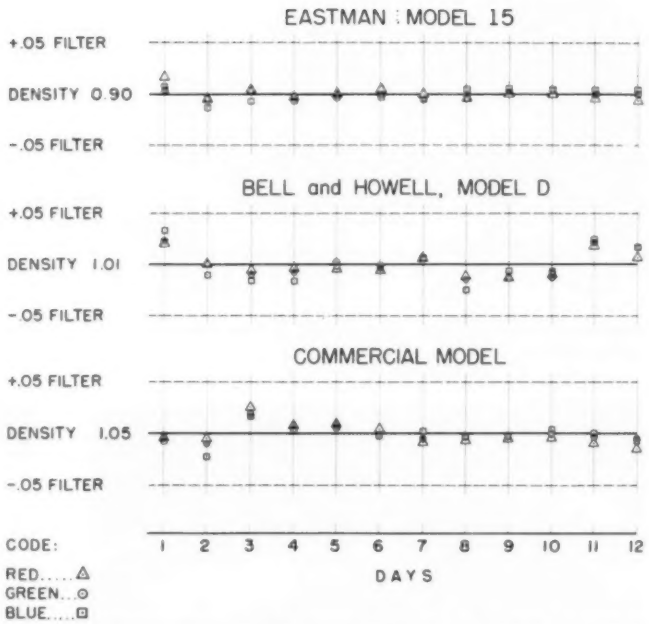


Fig. 7. Plot of exposure variability over the period of the test for each of the three instruments. The dashed limit-lines show the average variation produced in each case by a CC-05 filter.

Automatic Announcing Techniques for Television Stations

By R. A. ISBERG

Magnetic tape recordings of local announcements for use with film and network programs can be easily prepared at the convenience of the announcing staff. The equipment used for this purpose makes it possible to record most of the local announcements for an 18-hour operating day in less than an hour's time. Subaudible control tones, recorded after each announcement, automatically stop the tape transport. The technician on duty does not need to refer to the announcement continuity once he has started to play an announcement on the air. This technique can also be used with additional control tones to operate projection equipment, thereby eliminating errors on the part of operators when they are required to switch large numbers of slides during an announcement.

CONSIDERABLE ATTENTION has been given to the potentialities of automatic equipment as a means of improving television programming operations. Nevertheless, development of techniques has lagged, possibly because of general reluctance to discard proven methods. The experiences of a typical television station in converting to semiautomation in programming and broadcasting operations, as described in this paper, may point the way to future applications of automatic techniques to studio operations. A detailed description of station activities gives a vivid picture of day-to-day programming requirements.

Presented on October 8, 1957, at the Society's Convention at Philadelphia by R. A. Isberg, Ampex Corp., 934 Charter St., Redwood City, Calif.

(This paper was received on October 8, 1957.)

Figure 1 shows a simplified weekday program schedule for a typical network-affiliated station using semiautomatic announcing equipment. The first announcement is made just before the test pattern period at 6:30 a.m. and the last announcement occurs at the end of the sign-off prayer shortly before midnight.

During the intervening 17½ hours, approximately 50 announce breaks are required, each consisting of one to three short announcements varying in length from 2 to 20 sec. Musical introductions or sound effects are occasionally utilized for program introductions and endings.

In many instances, the only duty of the person in the announce booth is to give a 2-sec announcement such as "Channel Three, Big Town, USA," recited at half-hour intervals.

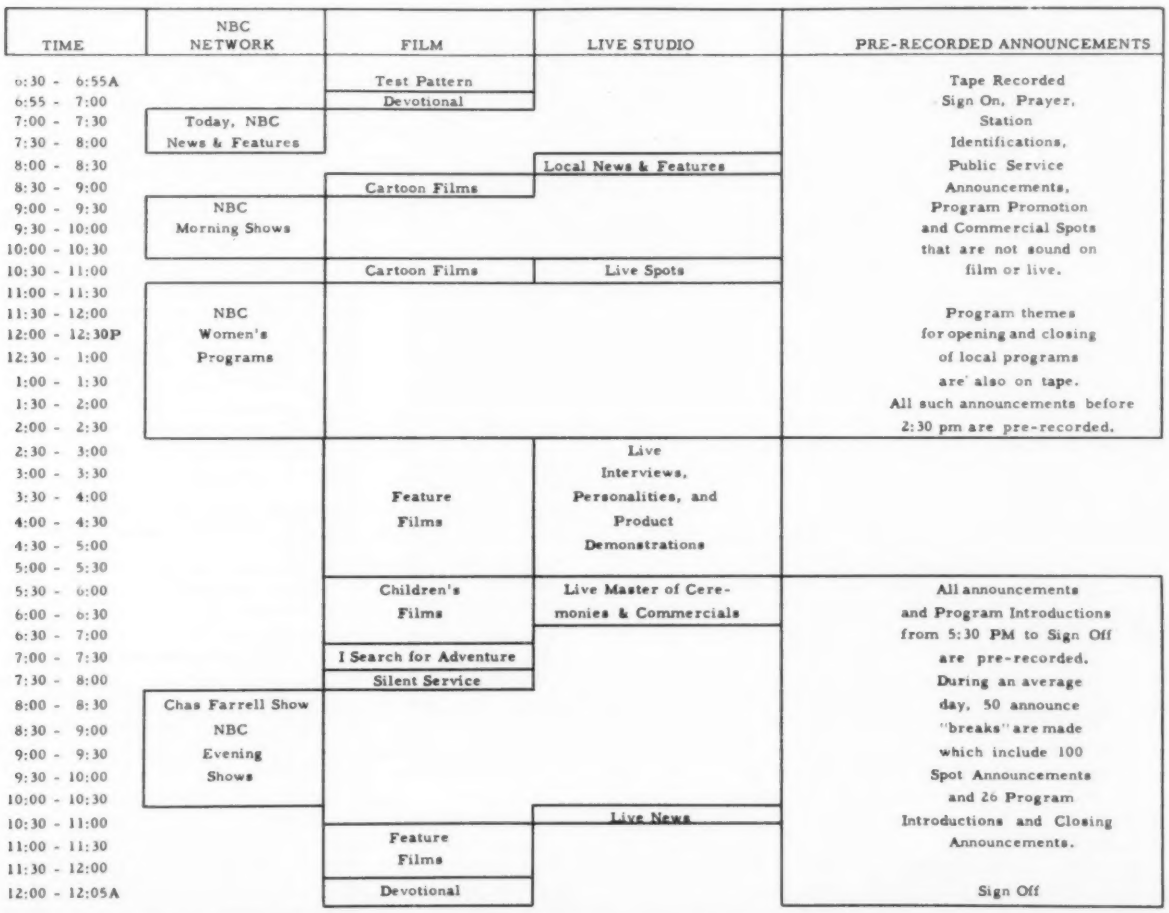


Fig. 1. Typical weekday program schedule of a network-affiliated television station showing use of prerecorded announcements.

Time	On	Off	Title & Sponsor	An'd as Spn'd	Origin	Video	MR Operator	Audio	Class	Type
700:00			I SEARCH FOR ADVENTURE "Whirlybirds" (29:33) Amer. Home Prds.		K	F		SOF	C	E
729:33			(17) Farrell Show PR		K	S		AB	C	
			(08) Three Star PR			S		AB	C	
			(02) ID			S		AB		
730:00			SILENT SERVICE "David & Goliath" (28:32) Burgermeister		K				C	E
			(15) Open (10) SOF			F 7-1-15		SOF		
			Film			F		SOF		
			1st Commercial			F 7-6-60		SOF		
						F		SOF		
			2nd Commercial			F 7-4-60		SOF		
						F		SOF		
			3rd Break							
			(30) Hamilton Frtn.			S 66-4 S 66-5 S 66-6 S 66-7 S 66-8 S 66-9		AB	P	
						F		SOF		
			(15) Close (10) SOF (05) AB			F 7-2-15		SOF AB		
759:30			(20) Rainbo		K	F 5-9-20		SOF	C	
			(08) Three Star PR			S 100-20		AB	C	
			(02) ID			S		AB		
800:00			CHARLES FARRELL SHOW Whitehall		NF	N		N	C	E

Fig. 2. Portion of operating log showing sources and time schedules for programs and spots. Announcements in audio column marked AB (announce booth) may be done either live or prerecorded. Outlining with crayon indicates to the audio control operator that they are on tape. SOF indicates sound-on-film and N indicates network audio.

The Use of Taped Announcements

By utilizing prerecorded announcements, this television station enables the morning program personnel to give undivided attention to the preparation and production of the live 8:00 a.m. news and local features program and the 10:30–11:00 a.m. children's program.

All of the routine off-camera announcements during station breaks between network programs and films, except for sound-on-film spots, are reproduced from tape, including the sign-on, the theme and the introduction to the 2:30 p.m. film feature program.

The 2:30 p.m. to 5:30 p.m. schedule features interviews, personalities, films and commercial presentations. This is the only extensive program period during the entire day that does not rely upon recorded announcements. Only the theme music for the opening and closing of the program is included in the announce tape.

Recorded announcements for the evening program are similarly integrated with sound-on-film spots during the station breaks between programs.

Integration of Pre-Recorded Announcements Into Television Programs

A typical operating sequence is shown in the traffic sheet for the audio requirements for the 7:00 p.m. to 8:30 p.m. program period (Fig. 2). The sequence begins with the station break at 7:29:33 p.m. at the end of *I Search for Adventure*, a sound-on-film local release. At the final cue dot on the film, the *Farrel Show* program promotion slide is shown and the recorded announcement is started. The next slide, promoting *Three Star Theatre*, and the final 2-sec station identification (ID) slide are shown on audio cue. The next feature film projector is started at 7:29:55. An Academy leader spliced to the film indicates on the preview monitor the time for switching from the ID slide to the film.

The tape-recorded announcement concludes with a 25-cycles/sec control tone which automatically stops the tape reproducer. This system is described as semiautomatic because it is manually started and automatically stopped.

Since the prerecorded announce tape has been timed to fit the 27-sec station break, the end of the tape-recorded audio will occur a second or two before the beginning of the 7:30 feature film.

The feature film has three participating commercials within its format. Those which are not on film or presented live have been prerecorded on tape. The exact starting time of each commercial depends upon the format of the show and is determined by cue marks inserted by the film editor. The first two commercials are sound-on-film inserts spliced into the film makeup. The third is a sequence of slides with tape audio. After the second cue mark appears on the feature film, the tape reproducer is started and the first slide is shown. The feature film projector is stopped after the count of 5 on the Academy leader, thus cuing it for the next start. The slides are shown in sequence on tape audio cue and by reference to the commercial continuity. Assuming the 30-sec commercial began at 7:43:00, the feature film is again rolled at 7:43:25. The tape-recorded audio concludes and the tape reproducer automatically stops at 7:43:30, when the feature film is resumed.

The same series of events take place within this show for the other breaks which do not have sound-on-film. The film ends at 7:59:15 as determined by previous film room timing. The 15-sec program close is spliced to the film and the closing 5-sec tape-recorded announcement is started on visual cue. At its conclusion, the tape reproducer automatically stops. The sound-on-film spot at 7:59:30 is spliced to the closing film announcement and continues to its conclusion. The tape reproducer is then started and a slide is shown, followed by a station ID slide shown on audio cue. The ID slide is held until time to switch to the network 8:00 p.m. show. The tape audio concludes with the ID at 7:59:59 and the tape reproducer automatically stops. The rest of the evening programming continues similarly.

Experience With Prerecorded Television Announcements

In two years of operation, the semiautomatic announcing system has been very reliable and the only equipment failure was due to a faulty tube. Emergency situations such as loss of network service, projector lamp failure or the parting of a film splice can be covered by the control room audio operator, who is also skilled as a combination audio announcer.

In the radio industry it is not unusual for announcers to act as combination announcer-technicians. This station conforms with this custom by employing announcers who are also qualified to operate equipment. Personnel assigned to record announcements for later television

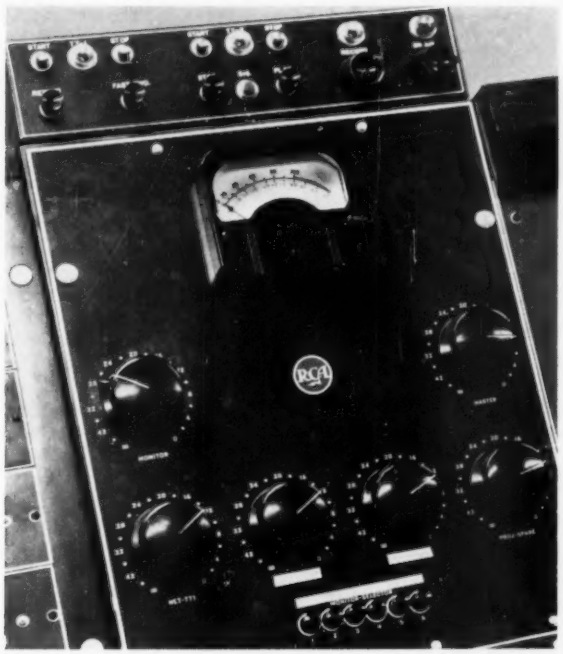




Fig. 4. Announce booth console. Headphone monitor permits choice of five program audio circuits. Timer can be used to integrate recording time automatically or can be manually controlled by a switch to measure program time. Two-way pushbuttons provide service between control room and booth. Clock can be stopped by depressing reset switch. Pushbuttons in bottom row control tape transport used for recording announcements.

Fig. 3. One remote control panel for the tape recorder is mounted on top of the audio-video master switcher console. A similar panel is mounted on the audio console.

use are provided with detailed information on film makeup, time allotted for spot announcements, program cues and other information from the traffic and program departments. A copy of the daily program log sheets (Fig. 2) is marked by the announcer as the recordings are made. This marked log is then given to the audio control man for his work sheet.

When a variety of voices is desired on the announce tape, several announcers are assigned to prepare the recordings. Since the tape recorder automatically stops at the conclusion of the 25-cycle tone inserted after each announcement, it is correctly cued for the beginning of the next announcement. Thus no time is lost, during either recording or playback, for cuing. If an error is made during recording, the announcer can quickly rewind the tape from his control panel and re-record the announcement. When music or sound effects are required, the announcements are recorded in the same manner as in a live broadcast. Some complex announcements which are used repeatedly are dubbed from a master recording.

Scheduling Recording Sessions

The announcements for a day's schedule are normally recorded in two 20-min sessions, one in the morning for the afternoon and evening programs, and one in the evening for the next day's morning and early afternoon programs. Each recording session is then almost certain to include late program changes.

When program timing is uncertain, such as during sports events or other special broadcasts, several sets of announcements can be prepared. The operator on duty will select the correct announcements as he analyzes the program situation. If a single substitute announcement is required, a qualified man will usually give it live from an announce booth unless time permits prerecording it.

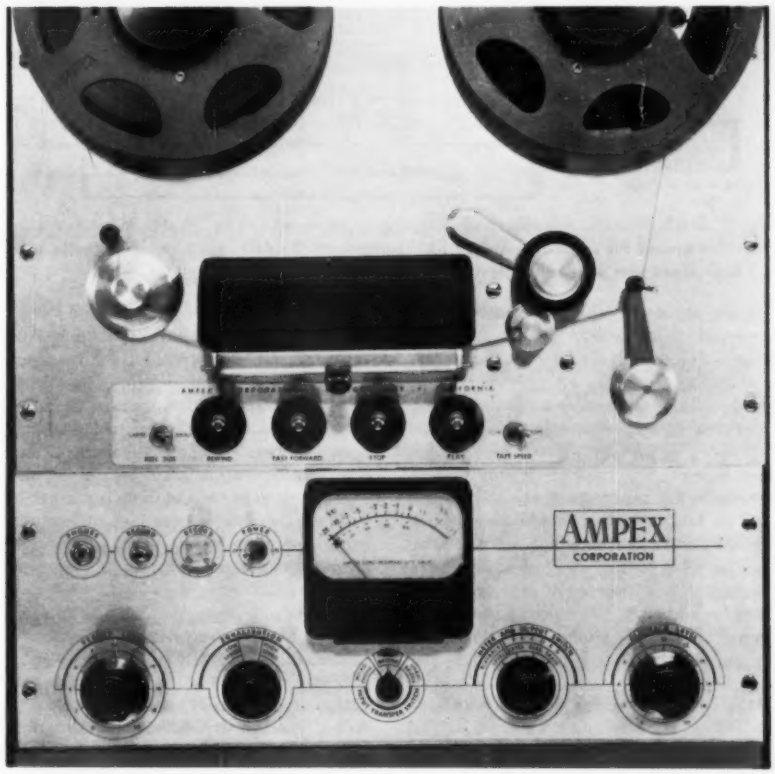


Fig. 5. Ampex Model 350 (shown above) with associated Model 355 Integrator housed immediately below it comprises a semiautomatic television announcing facility.

The ease in fitting programs together according to schedule chiefly depends upon normal care in film room makeup and accurate timing of the prerecorded announcements.

The overlapping of recorded an-

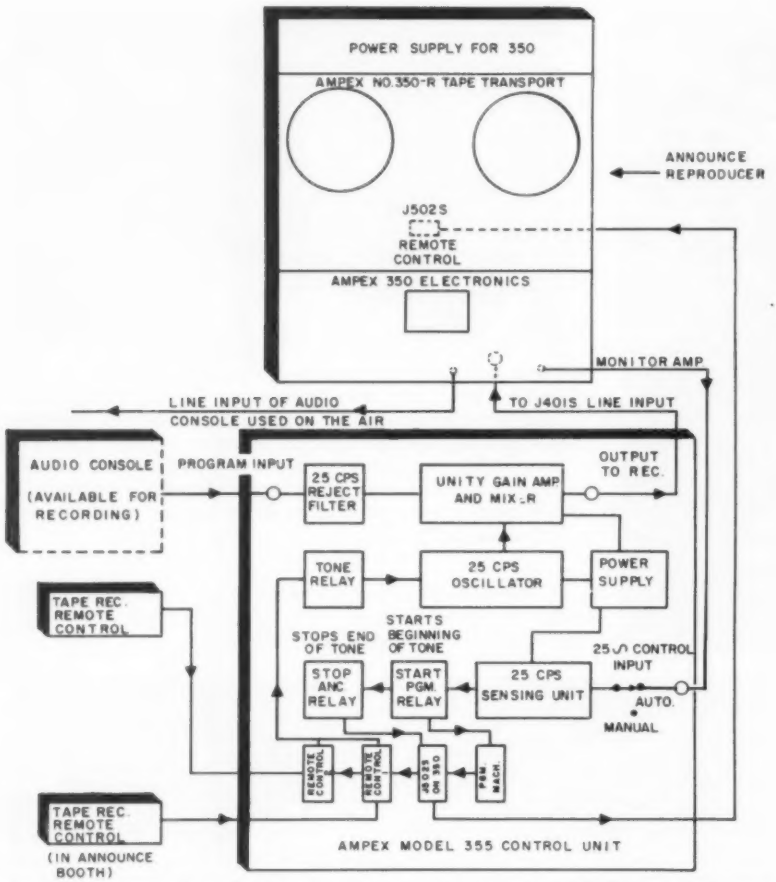


Fig. 6. Semiautomatic television announcing equipment. The Model 355 Integrator provides means for recording subaudible tones as well as circuits to automatically stop the tape transport when they are introduced.

nouncements with the next program has occurred infrequently. When such a situation seems likely to occur, the announcement can be given live by the combination announcer-audio operator on duty. Consideration is being given, however, to the installation of an Ampex Model 375 capstan motor power source in the tape reproducer. This unit can be modified to provide either 60-c (cycles per second) or a higher frequency, such as 66-c to the capstan motor, permitting a 10% increase in capstan speed. This would not be objectionable and would afford the switcher an opportunity to compress a 30-sec spot into a 27-sec time interval.

Equipment used for preparing and reproducing the announce tapes consists of a standard Ampex Model 350 tape recorder used in conjunction with a 25-c tone generator and an automatic tone-sensing and stop mechanism, plus the usual control room audio input and mixing facilities.

Control Room Equipment

Figure 3 shows the master switcher console with the tape recorder remote control panel mounted on its top surface. The tape recorder is rack-mounted with its automatic stop control and tone generator. Remote controls for the recorder are provided in three locations: the announce booth, the master switcher position and the audio control position. Any function — Tone, Record, Play, Stop, Rewind and Fast Forward — may be controlled at each of these positions.

The announcer's custom-built console in the announce booth is shown in Fig. 4. In addition to the controls for the tape recorder, a timer is provided which will automatically time the length of each individual recording as well as accumulate the total elapsed time of a series of recordings. Provision is also made for intercommunication with the control room, monitoring of several program sources, and the control for the announce microphone. These facilities are used while network or film programs are in progress to record announcements for later release.

After the equipment was originally installed, activities in the television control room became more complex. Eventually, another Ampex Model 350 recorder with a second automatic control system was installed for preparing recorded material (Fig. 5). The second system utilizes the production version of the Ampex Model 355 Integrator. This model includes all the features of the first custom built automatic control and tone generator systems within a single chassis.

Figure 6 shows schematically the Ampex Model 355 Integrator in a semiautomatic announcing system. This system provides a 25-c oscillator to generate the control tones which are recorded at the end of the announcements. The oscillator's output is controlled by a relay and mixed with the station's announce facilities output prior to recording. The mixer is a unity gain amplifier with an input filter which attenuates frequencies in the vicinity of 25 c, thus preventing low frequencies in the recording from triggering the 25-c sensing circuit, causing the machine to stop. The overall frequency response of the mixer is uniform ±2 db from 50 to 15,000 c. Since the 25-c oscillator is mixed with the audio after the filter, the control tones are not attenuated.

The monitor output of the tape recorder's playback amplifier feeds the 25-c sensing unit, which employs a high gain frequency selective amplifier tuned to 25 c. Upon receiving a 25-c tone, the start-program relay closes and remains closed for the duration of the tone signal. When used in automatic broadcasting this relay will start a record changer or a second tape reproducer. The closing of one set of this relay's contacts permits a capacitor to be charged. At the end of the tone signal, the same contacts connect the charged capacitor across the coil of the stop-announce relay which has a set of normally closed contacts connected in series with the tape reproducer's stop circuit. Thus the tape transport will be stopped at the end of a control tone and the tape is properly cued to record the next announcement. The added automatic control functions do not interfere with the manual operation of the tape recorder.

During recording, the announcer simply depresses the record remote control button, reads the announcement and depresses the tone button. The tape transport automatically stops. He can rewind the announcement, if he chooses, and check it for accuracy and delivery. The machine will automatically stop, properly cued for the next take. If dissatisfied with the announcement, the announcer can rewind to a point near the end of the preceding announcement, play to the conclusion, and the tape transport will automatically stop, ready to re-record.

The Ampex Model 355 Integrator is also used for automatic radio station systems, since it can start a second program source such as another tape recorder or an automatic record changer at the beginning of a control tone signal. By using a silence-sensing unit or micro-

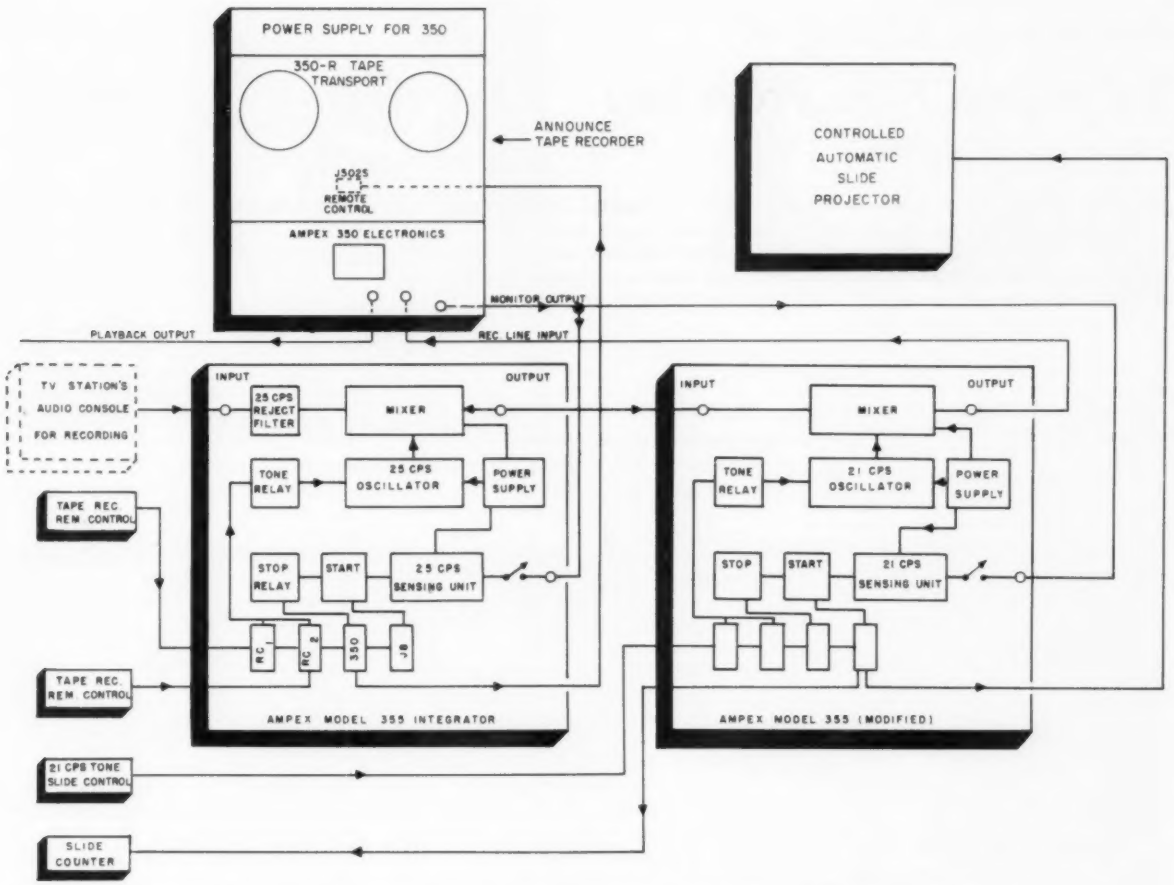


Fig. 7. A two-tone system for controlling an automatic slide projector as well as automatic stop for tape transport.

switches in a record changer, the announce tape machine can be automatically restarted.

Automatic Television Switching

Additional control functions may be added in a similar fashion to the television semiautomatic announcing system. For example, a 25-c tone can be used (as it is now) to stop the tape transport at the end of an announcement. A 21-c tone could pulse a slide projector to change slides in sequence with the continuity. This tone would be detected by a 21-c sensing amplifier similar to the 25-c sensing amplifier described above, but it will require only one relay to pulse the slide projector. If desired, a third tone (17-c) can be used to pulse another slide projector, operate a douser, or even to perform a video switching operation. Practical systems, such as the one shown in Fig. 7, can conceivably be designed to perform almost any operating function that should be coordinated with the prerecorded announce tape.

Possibilities for a Completely Automatic Television System

A television system can be made completely automatic by providing circuits which can be closed by the occurrence of a magnetic or notched cue mark on film (or a cue signal recorded on the audio or control track of a video tape recorder) to start an announce tape reproducer. In this manner, the motion-picture projector or video tape recorder can control the announce tape reproducer, which in turn will control the associated projection and switching facilities.

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Discussion

Spencer W. Caldwell (S. W. Caldwell, Ltd.): Can the 25-cycle tones also change the slides?

Mr. Isberg: One tone is required for each control function. If one were to use an automatic tape reproducer stop as well as an automatic slide changer, another tone and another sensing unit would be required. Since I had only one sensing unit here in Philadelphia, I set it up simply to use the 25-cycle tone to operate the slide projector.

Mr. Caldwell: Then if you had two slide projectors, you'd have three tones?

Mr. Isberg: Yes, one could utilize three tones. In fact, there could probably be as many as six tones.

Mr. Caldwell: With the motion-picture projectors?

Mr. Isberg: Yes. And one could make up combinations of sequences of tones for controlling operations. A digital system could be as extensive as imagination and ingenuity will permit.

Mr. Caldwell: Where do you suggest that the tones go from 25 cycles, up or down?

Mr. Isberg: Well, generally not higher than 36 cycles and not much lower than 15. We have used tones down to 15 cycles very successfully.

Automatic Cuing of Television Film Projectors

By B. F. MELCHIONNI

With the advent of automation in TV stations, it has become apparent that methods must be developed to cue the film automatically at the start of each film sequence. This paper describes methods for automatically stopping a projector with a predetermined frame in the gate by adding suitable cuing information to the film and associated reading and control mechanisms to the projector.

IT HAS BEEN COMMON PRACTICE for many years to thread TV or theater projectors with a specific film frame in the gate. Most TV stations have established a run-up time on their projectors. This may vary from 2 to 5 seconds, depending on the particular station's practice. In conforming with this practice, the projectionist places in the gate a certain cue frame, usually located in a leader section of the film, so that the producer or director may start the projector with adequate time for stabilization before the signal is switched on the air. Different stations accomplish this in different ways. Some operators manually thread the machine with the required frame in the gate and assume that the projector is ready to go. In some TV studios the operator threads the machine, then manually rolls in the required frame, using the hand turnover now supplied on most TV projectors. Still others thread the projector with excess leader and then "jockey" the cue frame in the gate by manipulating the start and stop buttons on the projector.

When these systems are used, the machine must be rethreaded between all sequences by an operator, if more than one film sequence is spliced on a reel of film. The system described here will automatically reset or cue itself after each picture sequence. The user of this equipment may splice as many sequences as he wishes on a reel of film without the necessity of rethreading or manually jockeying the projector after each sequence.

Splicing the proper length of leader ahead of and between sequences is not very satisfactory because the run-down or stopping time of TV projectors is not very constant. It can vary from 2 to 4 seconds depending on the temperature of the projector and on the efficiency of mechanical or electrical braking. This inaccuracy is detrimental if the projector is to be run for several sequences without having to rethread or check the cuing.

Presented on October 8, 1957, at the Society's Convention at Philadelphia by B. F. Melchionni, Bldg. 10-3, Radio Corp. of America, Camden 2, N.J.
(This paper was received on October 8, 1957.)

Possible Methods

One possible method of controlling the stopping of TV projectors is full mechanical braking; but this has been tried and quickly discarded because of the probability of excessive wear and tear. It could cause serious difficulties in mechanical parts of the projector and damage film. Controlled coasting or run-down seems to offer a better way to accomplish the desired result with less likelihood of damaging the equipment.

A simple procedure is to put a timer in the projector to allow normal run-down for a specific time then effect a rapid stop with a mechanical brake. It was found that this system is not practical because it lacks the precision to bring about repeatedly a stop at a given frame. There are several reasons for this, the principal one being the variable run-down rate. The possible tolerances in timers and the overall accuracy of such a system, taken together, do not yield the required reliability.

A Method of Measuring Film Motion

The method chosen has the controlled stopping action related directly to the film motion, making it completely independent of variations in run-down time. The mechanism actually counts the number of frames passing a given point while the projector is decelerating and then applies a mechanical brake to bring it quickly to a stop. This idea has been applied to a system developed for the RCA TP-6 series of TV projectors.

A convenient way of measuring film motion is to utilize the rotation of a sprocket. Figure 1 shows the film path of the RCA TP-6 with the several sprockets in the film path. The most convenient of these for the controlled stopping mechanism is the upper feed sprocket. Figure 2 shows the shaft for this sprocket extended out through the protective Plexiglas cover over the upper gearbox on the back of the projector.

The input shaft to a magnetic clutch is driven by a set of bevel gears from the sprocket shaft. The output of the clutch drives a special "count-down" cam. When the magnetic clutch is energized, this cam is coupled tightly to the film motion.

Initiation of the operation depends upon a cue signal, to be described later. When a cue signal is received by the projector, the following takes place:

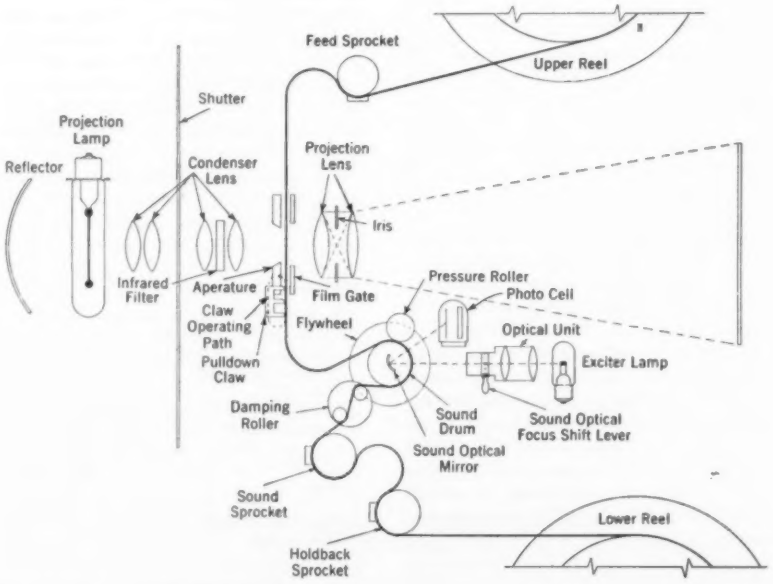


Fig. 1. Film path of RCA TP-6.

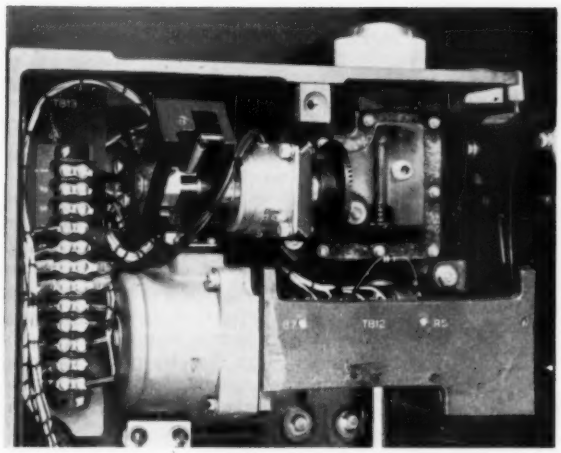


Fig. 2. Back of projector showing shaft for upper feed sprocket extended through Plexiglas cover on upper gearbox.

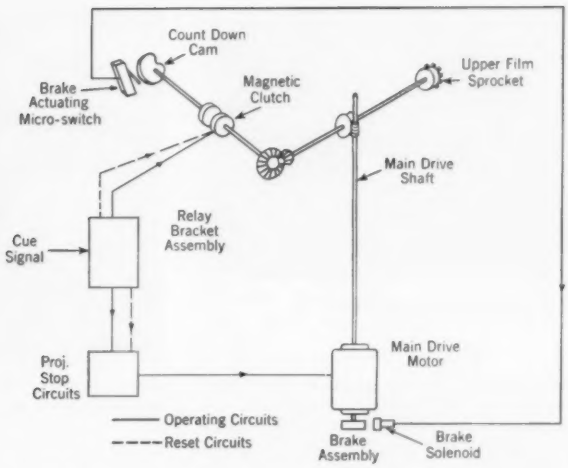


Fig. 3. Schematic of operating and reset circuits.

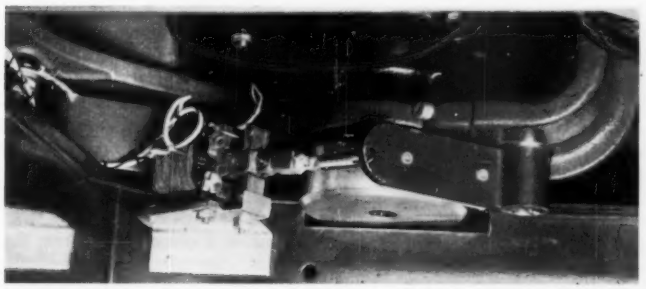


Fig. 4. Brake assembly mounted on casting support of main drive motor.

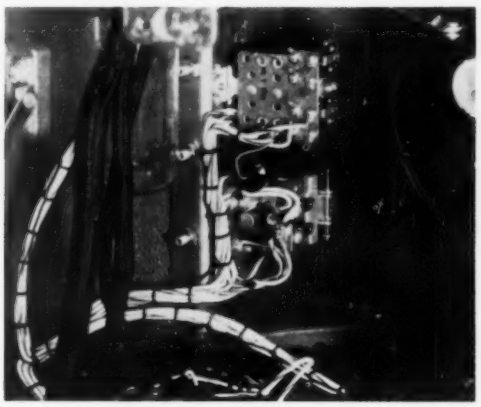


Fig. 5. Control circuits installed in TP-6 projector.

(1) The normal projector stopping circuits are actuated and at the same time the magnetic clutch on the count-down cam is energized.

(2) The cam starts to measure the film as it passes through the projector during the first part of the deceleration.

(3) After a predetermined number of frames (adjustable from 22 to 26 frames) the cam will close a microswitch which energizes the solenoid on the brake.

(4) By this time the projector is rotating at a relatively slow rate and when the brake is applied it can be brought to a full stop in less than one revolution of the main drive motor.

(5) After a short interval the magnetic clutch and the brake are released to be in readiness for the next sequence.

Figure 4 shows the brake assembly mounted directly on the casting which supports the main drive motor. This motor has a shaft projecting from each end. On the lower shaft is mounted a large-diameter brake drum; and the shoe, which is actuated by a solenoid. Although this brake assembly is fairly light it is more than adequate to stop the projector in less than one revolution of the drive motor after the initial period of deceleration.

Control Circuits

The cue signal closes a relay which energizes the magnetic clutch and the normal stopping controls. In addition a 5-sec time-delay relay is released. At the end of the 5-sec period this relay releases the magnetic clutch. The cam mounted on the magnetic clutch is spring-loaded. When this cam returns to the zero position, the microswitch is released removing the power from the brake assembly. The time required between film sequences to stop and reset the projector automatically with the next cuing frame in the gate is 5 sec.

These circuits added to the RCA TP-6 Projector do not interfere with conventional operation, if that is wanted (Fig. 5).

Methods of Cuing

The system will operate with any external cuing device that can supply a closed switch circuit of sufficient duration to energize the control relay which is part of the automatic cuing attachment.

One method of automatic cuing which has been successfully used employs an audio tone. In this system a piece of SMPTE 400-cycle level-setting film (or any other suitable frequency) is spliced into the film leader. The number of frames is determined by the normal picture-sound separation of 26 frames plus the 22 to 26 frames required to stop the projector. Thus the inserted tone is to start at 48 to 52 frames ahead of the cuing frame which is to be in the gate when the projector stops. The exact number of frames is selected by the user and the microswitch on the count-down cam is set accordingly. Tests have shown that a piece of 400-cycle film approximately 10 frames long is more than adequate to supply the cuing signal. Actually, the system will operate on less than two frames.

It is standard practice in TV stations to switch away from a projector optically and electrically before stopping it. When the automatic cuing system is used, it is recommended that the sound output of the projector be switched from the program line to the cuing amplifier (Fig. 6). This arrangement had several advantages.The most important advantage is that the projector cannot be stopped



Fig. 6. Cue sense amplifier.

accidentally on the air by a prolonged note of the right pitch; in addition, the cuing amplifier does not load the audio output line but is connected only when required. Most of the RCA multiplexers have facilities for accomplishing this switching automatically when the signal is transferred from one input source to another.

When the cuing amplifier is switched into the circuit, it amplifies the incoming signal through a frequency-selective network. When the signal is of the proper frequency, it actuates a relay which in turn causes the control relay in the automatic cuing attachment to operate.

Although the system uses an optical soundtrack, equivalent performance could be obtained with film having a magnetic soundtrack if the necessary allowance is made for the 28-frame separation between sound and picture.

It has been suggested that the balance stripe on magnetic film could be used to supply the cuing tone. This is definitely feasible but such a system would require the presence of a balance stripe on every piece of film.

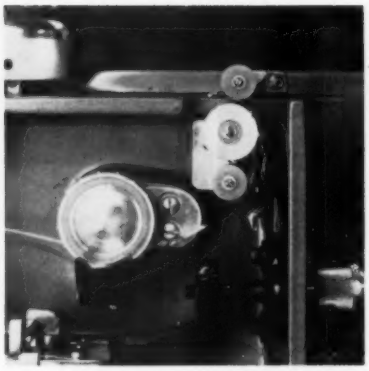


Fig. 7. Arrangement for conductive patch applied over soundtrack of film.

Another very promising device is a conductive patch which may be applied over the soundtrack of the film. This device has been used successfully for control in automatic film printers. Tests indicate that such a system works very satisfactorily (Fig. 7). A split roller is installed just ahead of the upper film sprocket in place of the reel guide rollers. The split roller is mounted between two guide rollers to insure sufficient wrap of the film on the split roller for good contact. Brushes ride on the roller flanges and these in turn are wired directly to the relay circuits within the projector.

The conductive patch material employed in this system is aluminum foil with a silicone adhesive backing This type of foil was found to be very durable and capable of going through the machine many times without damage. In actual tests the same strip was run through 50 times without apparent deterioration.

This conductive patch system has a number of outstanding advantages. One of the most important is its complete separation from the audio system. An even more important advantage is that the patches can be applied to the film without cutting or splicing and can be removed after use without any damage to the film.

The conductive patch need be no more than $1\frac{1}{4}$ inches in length. It is normally located after the cuing frame but close enough to it so that the patch passes through the gate position during the normal run-up of the projector. It cannot, therefore, show on the air or affect the sound.

Conclusion

This equipment can be installed in existing TP-6 projectors. It will contribute toward the conservation of manpower and time. It would also make for a more uniform operation and tend to standardize station practices. The equipment is designed to stop repeatedly within $\pm$ 1 frame of any designated frame. This mode of operation becomes particularly necessary in a completely automatic system where the entire day's film requirements may be prepared in advance and, once the projector is threaded and initially cued, it need not be touched again until the reel of film runs out.

Acknowledgments

The author wishes to thank R. D. Houck for the assistance in designing the electrical control circuits associated with the above equipment.

A Studio-Type and a Portable-Type System for Synchronizing $\frac{1}{4}$-Inch Magnetic Tape With Perforated Motion-Picture Film

By EDWARD P. KENNEDY

The method of utilizing synchronously driven toothed sprockets engaging complementary film sprocket holes for sound-film production is, of course, an old technique. The introduction in 1947 of sound magnetic tape having a thin and easily torn base of cellulose acetate made sprocket holes highly impractical. The two systems discussed in this paper employ magnetic equivalents of sprocket holes recorded along the tape simultaneously with the recorded sound and at the exact time of frame exposure in the camera. The "latent magnetic sprocket holes" are later reproduced to serve as a master speed control device to govern the speed of the picture film through playback equipment.

A SYNCHRONOUSLY DRIVEN camera, microphone and tape recorder comprise a "taking" unit. The camera exposes film at 24 frames/sec. The tape recorder, running simultaneously, records both the instantaneous power-line frequency at the moment of recording, together with the sound picked up by the microphone on the same tape. Both are recorded in a way to prevent each signal from interfering with the other. Clapslate marks for relating the start of sound and picture are made in the standard manner. These later serve as starting marks for playback beginning.

During playback, the sound is picked up from the tape and reproduced normally. The magnetic recording of the power-line frequency is simultaneously reproduced and channeled to serve as the master speed control of slave-driven film equipment such as a projector or synchronous soundtrack transfer equipment.

It should be noted that the linear velocity of the tape is not changed during either recording or playback, so it remains constant within the limits of the performance of the tape transporting mechanism. Tape mechanisms of professional quality seldom produce flutter and wow exceeding 0.1%; therefore, such sound is accepted by the ear as quite satisfactory, and the synchronizing signal is reproduced with equal fidelity.

If the tape is run at a fixed velocity during playback, obviously the film must be made to vary slightly in velocity to maintain synchronous relationship, to compensate for tape slip, shrink or stretch and for very slight changes in power-line frequency during the time of the take. It is fortunate that, for applications such as this, the eye will not detect the small changes occurring in the motion-picture frame rate per second to maintain seemingly synchronous relationship between sound and picture during projection.

A paper, now somewhat shortened, presented in original form on May 28, 1954, at the Society of Photographic Engineers Meeting at West Point, N.Y., by Edward P. Kennedy (U.S. Army Signal Engineering Laboratories), 752 Ocean Ave., West End, N.J.

(This paper was first received on May 16, 1957.)

Carrier Taking System

The first taking system developed was a carrier type (Fig. 1). It consisted of the fundamental components of synchronous camera, recorder and microphone. Inserted into the original recording circuit was a 20-kc oscillator which supplied the carrier frequency for the 60-cycle synchronizing signal. The quality of tape available at that time was the basis for choosing 20 kc as about the highest frequency that could be reliably recorded and reproduced. This system was reasonably successful as a laboratory model, but was soon shelved in favor of a simple divided-track taking method, described later.

Magnetic Amplifier Playback System

The first playback system developed was intended for non-mobile use. Amplifying the tape-carried synchronizing signal to a sufficient and reliable power level for starting and driving synchronous motors on reproducing equipment proved to be a major undertaking. Electronic amplifiers were first considered but were abandoned because of their complexity and likelihood of com-

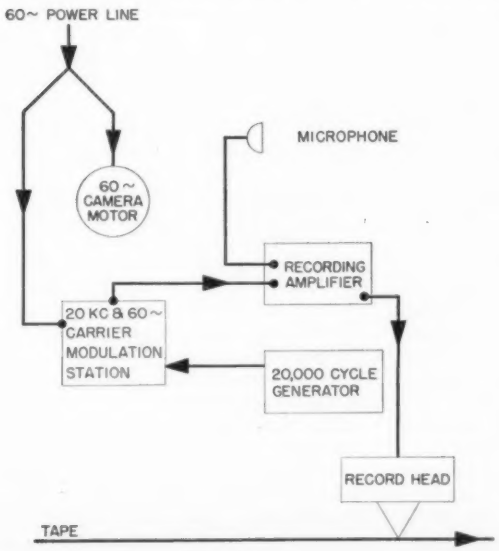


Fig. 1. Carrier taking system.

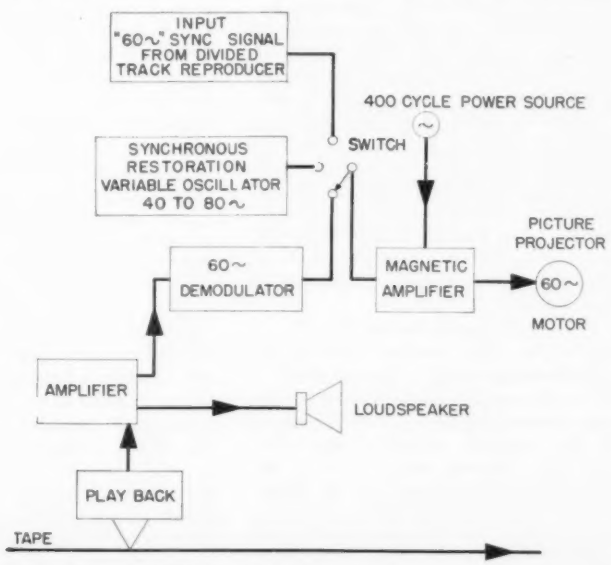


Fig. 2. Magnetic amplifier playback system.

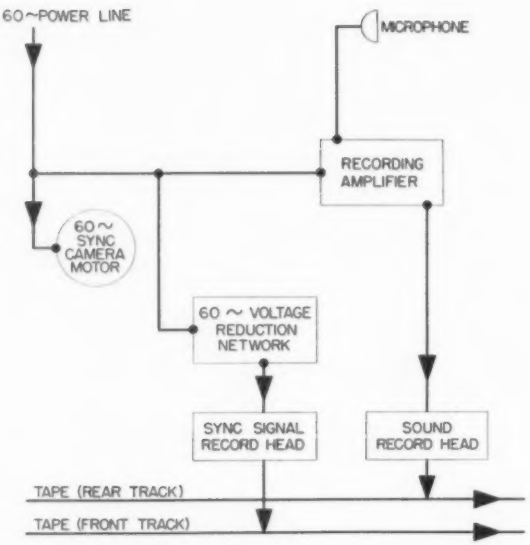


Fig. 3. Lightweight, field taking system.

ponent failure in service. Also, they present very poor output regulation characteristics when they are looking into the continuously varying impedance presented by a synchronous motor, particularly during its starting period under load.

High-gain magnetic amplifiers were next considered because they could be constructed of rugged components and present a more favorable output impedance characteristic for starting and running the playback or transfer motor. Improvements then being made in magnetic core and rectifier material made this approach feasible (Fig. 2). Purchasing a magnetic amplifier for this application was not as easy as literature of the time would indicate. One manufacturer, after evidencing considerable reluctance, designed a circuit and built the components for what is believed to be the first magnetic amplifier to start and run a loaded synchronous motor of the required size.

After the validity of this approach had become reasonably well established, the USASEL designed and built a more specialized and higher capacity magnetic amplifier which has given satisfactory performance. Patent No. 2,745,056 was granted to M. B. Zucchino, then of USASEL, for his invention of this system component.*

The power source for this amplifier is 400 cycles. The nominal tape-carried synchronizing signal to be amplified is 60 cycles, taken from the output of the tape reproducing system, then impressed on the magnetic amplifier input. The respective nominal impedances at this junction are 16 ohms into 16 ohms. The voltage across this circuit is 16 v; current is held at approximately $\frac{1}{10}$ amp.

The magnetic amplifier output into the film-driving mechanism motor is 115 v. The running load current is about 0.5 amp. The instantaneous starting current surge into the motor is about 6 amp. The tape from standstill to 15 in./sec requires about 0.75 sec. The slave motor driving the film follows this frequency rise and locks into exact synchronism in about the same time interval. When stopping, the driving power is switched off the tape reproducer motor, but the 400-cycle power to the magnetic amplifier remains on; therefore, as the tape-carried synchronizing signal slows down it falls in frequency and the film-driving motor follows it down synchronously until the tape signal drops below about 10 cycles, at which time the synchronous control power during slowdown gradually falls below complete dependability. If, however, the brakes on the tape reproducer are properly adjusted, the remaining, partially controlled, slowdown of the film-drive equipment will cause it to stop in close synchronous relationship with the tape.

The original magnetic amplifier input circuit contained a "flip-flop" circuit which automatically substituted the 60-cycle power-line frequency to serve as a fill-in during momentary dropouts of the tape-carried synchronizing signal. For other corrections, there is a local 40- to 80-cycle built-in oscillator which, when manually switched into the control circuit and manually operated, provides the means, during dynamic operation, of either speeding up or slowing down the film to restore synchronization. After restoration, the speed control is returned to the tape-carried control track.

Aside from motion-picture applications there are excellent possibilities of this method being developed into an accurate, and infinitely variable, speed control for a-c motors, an application believed to be unique. For example: When an audio oscillator is connected to the input of this magnetic amplifier, it causes the four-pole, capacitor-type, 60-cycle synchronous motor (of standard manufacture) to start and run a light load in synchronism with the oscillator frequency anywhere between 17 and 80 cycles/sec, which results in a synchronous speed range of from 510 rpm to 2400 rpm.

Lightweight Field Taking System

This system is known as the "divided track" method. As depicted in Fig. 3, it was developed for military field use in early 1952 after commercial tape had been improved so that the magnetic oxide coating could be considered dependably uniform throughout the whole width and length of the tape. Synchronizing dropouts have since ceased to be a major problem. For "single opportunity" takes, however, selected and pretested tapes are recommended.

For field use where commercial power is not available, a suitable battery-driven dynamotor or well-governed gasoline engine-generator set will provide the needed 60-cycle power facility.

For playback, the magnetic amplifier playback system (Fig. 2), with slight modification at its input, or the portable lightweight playback system is adequate; or a portable playback system (Fig. 4) may be used with this taking system with equally satisfactory results.

Portable Playback System

The magnetic amplifier system is not considered suitable for portable field service chiefly because of the 400-cycle power supply needed for its use. To provide a practical portable playback equipment, there was developed the concept of utilizing the standard 60-cycle power-line facility to supply *almost* enough power to bring the film-driving "universal" motor up to synchronous speed, then supplying the *balance of the power needed* with a positively coupled synchronous motor powered from the amplification of the tape-carried synchronizing signal itself. The mechanical speed control governor was removed from the "universal" motor. Consideration of a standard electronic amplifier to accomplish this was dropped for some of the same reasons given above.

As a low-bulk and relatively lightweight means of "amplifying" the tape-carried synchronizing signal, a simple push-pull thyratron inverter was investigated. Little useful information was found in the literature except for a comprehensive theoretical treatise on inverters by Dr. Herbert J. Reich in his book *Theory and Application of Electron Tubes*.

* M. B. Zucchino, "Magnetic amplifiers for synchronous motors," *Electronics, 27:* 133, Mar. 1954. This article contains engineering and construction data.

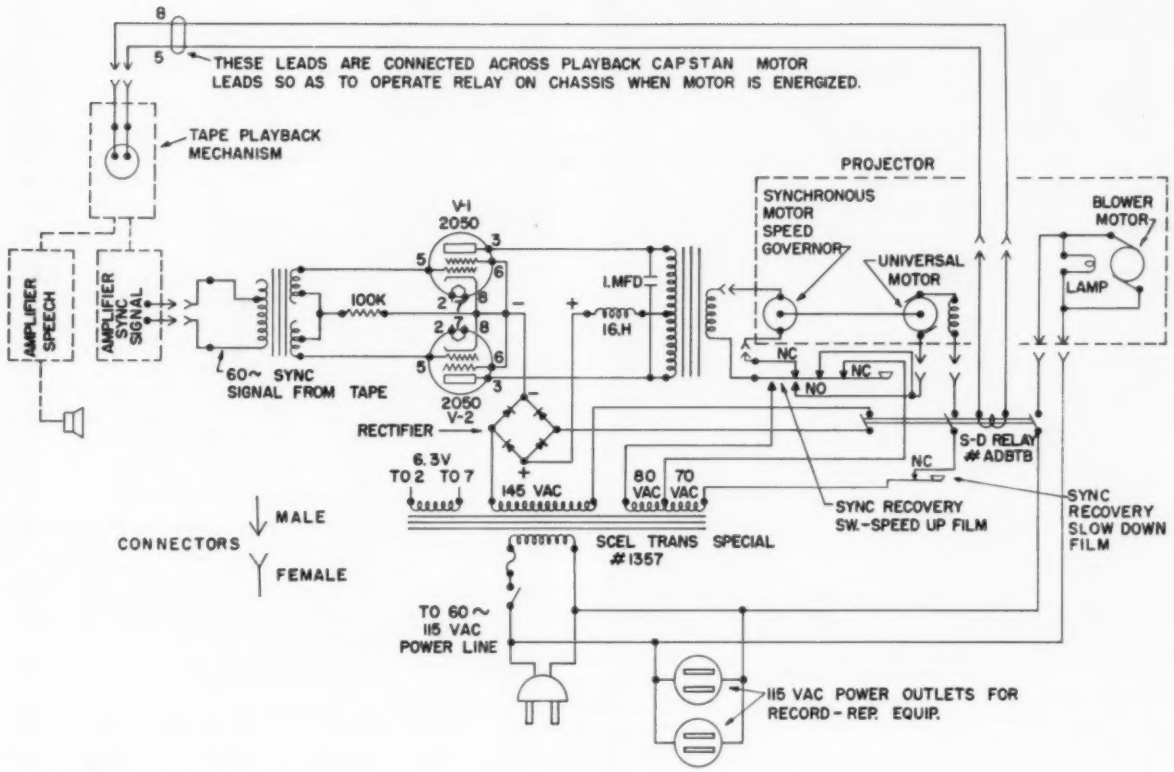


Fig. 4. Portable playback system.

An experimental model inverter was designed according to Dr. Reich's information. A built-in power supply for the inverter and "universal" motor was added. With minor improvements made as experience was accumulated, this inverter supplied the required additional torque necessary for the pulling-in and locking-in of the synchronous motor used as a co-driver of the motion-picture film mechanism.

A typical working model of this portable playback system consists of a slightly modified binaural tape reproducer, a thyratron inverter unit, a modified JAN-type 16mm motion-picture projector and a suitable loudspeaker with interconnecting cables.

The only modification of the playback tape reproducer is the addition of a two-wire connector connected across the power input terminals of the capstan driving motor. A cable leading from this connector supplies the closing energy to the master control relay on the inverter chassis at the same instant that the reproducer motor is switched on.

Arrangement of the thyratron inverter and its power supply is shown schematically in Fig. 4. To be noted particularly is the means provided for synchronous restoration between sound and picture during operation, should they accidentally become nonsynchronous. For example; should the picture fall behind the sound, depressing the 5-contact Speed-Up-Film switch causes the release of the tape-carried speed control signal and instantly raises the voltage impressed on the "universal" motor, which causes it to speed up. When the operator observes that the film has overtaken the tape sound, his release of the switch returns the film speed control to the tape signal.

Conversely, when the picture is observed to be ahead of the sound, depressing the Slow-Down-Film switch causes the film velocity to drop simply because of lack of film-driving power. Experience has shown that a good operator very quickly learns this film-speed-changing technique and brings about synchronous restoration without an average audience becoming critical or aware of any minor manipulations in the film velocity. Normally, these manipulations are unnecessary.

A Newly Designed Optical Printer

By VERN W. PALEN

A new optical printer has been designed with many new features incorporated in one completely coordinated unit. These features are enumerated and their functions described.

THE OPTICAL PRINTER described here has been designed by John Oxberry with the aim of constructing a printer for high-quality work accomplished with a minimum of time and effort required of the operator. The new printer incorporates a number of noteworthy features:

1. Automatic follow-focus controlled through one lead screw covers a range of from 1-to-3 blow-up through 1-to-1 down to 4-to-1 reduction.
2. Automatic dissolve provides up to 50 settings ranging from 8 to 120 frames.
3. Interchangeable film transport mechanisms accommodate 35mm and 16mm in one housing which remains in place on the printer to maintain precision alignment.
4. Tilting mechanism aligns a scene precisely without distortion.
5. Improved movements permit adjustments of less than 0.001 in. on lens mount and projector head.
6. Higher efficiency lens and light systems deliver more illumination to the film surface than is possible with straight condensers.
7. Solid steel shafts are used to maintain alignment at all points and permit an extension of lens and camera travel (Fig. 1).

General Construction

To assure stability, the basic console is designed with interlocking, strain-relieved castings which weigh approximately ½ ton. All motors, blower and transmission mechanisms are mounted on a separate steel chassis isolated from the frame on which optical equipment is attached.

The printer has a variable-speed drive, designed to operate at stop-motion speeds through a range of 50 to 240 rpm, which permits the selection of any intermediate speed. An electric tachometer indicates the speed (rpm) at which the printer is operating.

A compact clutch system is employed to speed manual work and facilitate skip-frame tasks which add or drop frames to slow down or speed up the action. An auxiliary mechanism can be provided for automatic skip-frame operation.

Working space between camera and projector is approximately 28 in., allowing the installation of anamorphic and other special lenses. There are 5 counters, 3 for film footage and 2 for position. Five dial indicators facilitate interrelated positioning by the operator.

Dimensions of the printer are: height, 72 in., length, 65 in., width, 28 in. Installation space should provide 18 in. to the rear for servicing, 36 in. at the front for the operator, 18 in. on the camera end, and 18 in. on the projector end. The complete printer weighs approximately 2100 lbs.

Operating on a 115-v, 60-cycle supply, the unit can also be supplied for operation on 50 cycles, either 115 or 230 v. A panel board on the side of the printer includes a safety switch, bypass switch, and other operational controls. Removable plates provide accessibility to electrical and mechanical parts. A duct system permits oiling of a dozen major points by applying lubrication at one location (Fig. 2).

Manual Follow-Focus

The system permits rapid manual zooms and also provides for predetermining zooms and for repeating zooms accurately through use of mechanical indicators and a scale. Two lead screws are built into the unit, one for the lens mount and one for the camera mount. Each lead screw is provided with a mechanical counter and handwheel. This system permits maintenance of optical center with a minimum of friction for delicate optical axis positioning.

A guide scale with field calibrations is provided for the manual follow-focus operation. Two special flip-over counters designate zoom positions for lens and camera in 100ths of an inch. A calibrated dial subdivides the readings into 100ths of an inch.

Some Automatic Features

The automatic iris adjusts the camera lens automatically, thus eliminating one operation when doing manual follow-focus. Exposure stops are cam-operated throughout the changeover from 3-to-1 blow-up to 4-to-1 reduction.

The automatic skip-frame mechanism may be added to the printer at any time if provision for the addition is made when the unit is under construction. This device automatically handles 1 to 8 frames in the camera, 1 to 8 frames in the projector, or any combination within these limits.

The printer can be made with a built-in feature for automatic focusing through a continuous range from 1-to-3 enlargements through 1-to-1 and down to 4-to-1 reductions. Camera and lens mounts have an additional 1½-in. movement to

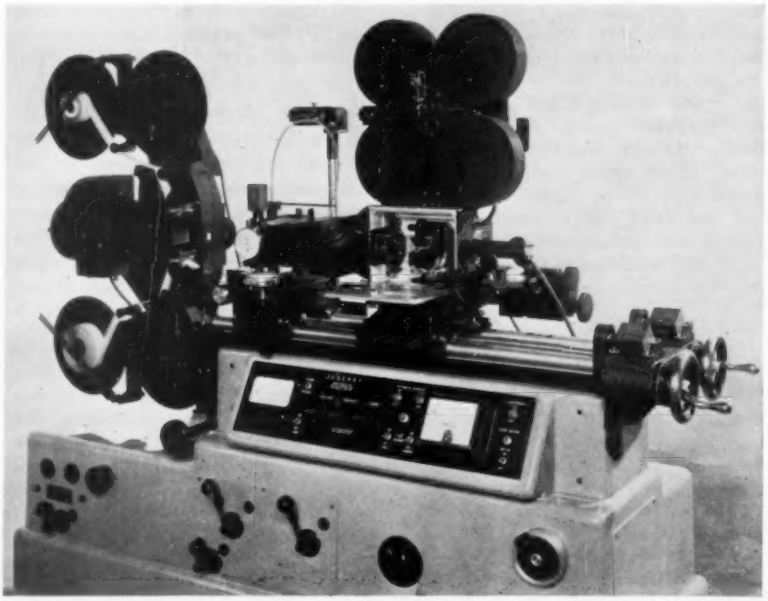


Fig. 1. View of machine, showing control panel and steel shaftways on which the ball-bearing lens and camera mounts travel.

A contribution submitted November 25, 1957, by Vern W. Palen, Animation Equipment Corp., 38 Hudson St., New Rochelle, N.Y.

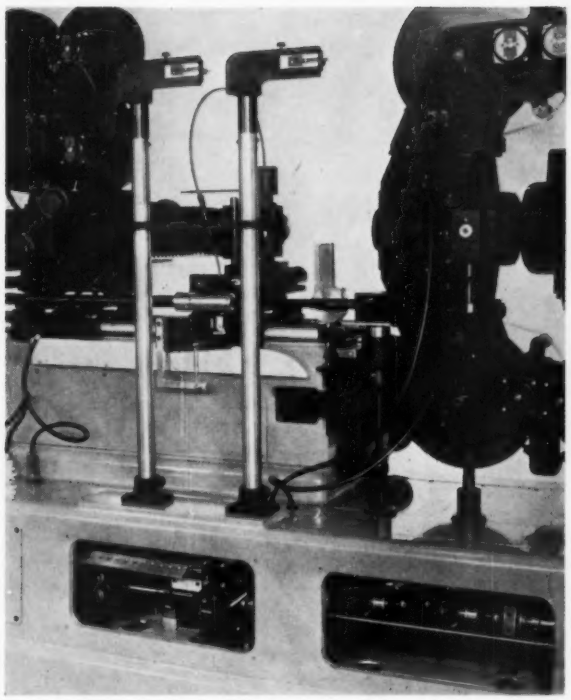


Fig. 2. Close-up of rear of machine showing (below) centralized oiling system. Motors on four spindles may be seen behind reels on camera and projector.

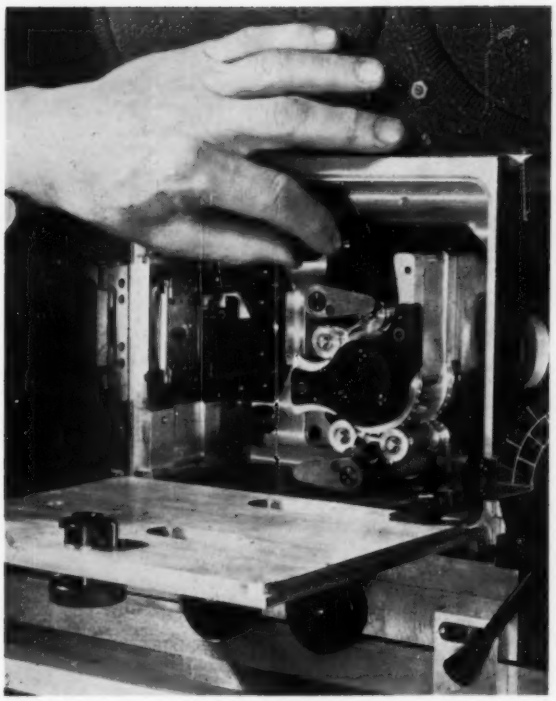


Fig. 3. Close-up of inside of camera housing. Sprocket assembly is replaced by removing two knurled screws, one of which can be seen between the fingers of the operator.

allow for out-of-focus shots. This is in addition to normal lead screw movements and is useful for focusing flip-lens and other similar tasks.

Precision and Economy of Operation

The dissolve mechanism saves time since it operates from 8 through 120 frames for a dissolve and is actuated by an infinitely variable speed unit. This is a straight cross-dissolve mechanism that permits selection of 10, 11, 12 or any number of frames up to 120 and is especially useful for short dissolves such as are in demand for television. A two-position switch controls and indicates shutter position as to cross-dissolve-in or cross-dissolve-out. Camera dissolve action is started by a button on the control panel and after the correct number of frames are exposed, the dissolve mechanism disengages automatically.

The automatic dissolve allows the operator to stop-motion a frame at a time with the shutter closing at its predetermined position each revolution. In other words, frames can be exposed with stop-motion while the automatic dissolve is engaged. A reversing switch permits operation of the camera with a designated dissolve in reverse.

A knob is provided, together with a logarithmic calibrated scale for fade-in and fade-out. Logarithmic scales are marked for 16 and 24 frames to suit customer preference.

The following actions are possible with the automatic dissolve: (1) automatic linear cross dissolve, (2) wide range of selection from 8 to 120 frames, (3) forward dissolve and reverse dissolve, (4) stop-motion and continuous and, (5) nonlinear hand scale for fade-outs.

The 170° dissolve scale is marked in frames so it can be used for 35mm or 16mm films. The linear mechanical system gives equal segments for each designated dissolve. There are two scales calibrated in 16ths and 24ths. An extension handle on the hand dissolve permits easy operation.

The film transport mechanism has been designed to avoid critical alignment problems. The new design employs one housing for both film sizes and this housing remains in place on the printer at all times. Only the shuttles and sprocket assemblies (Fig. 3) are changed for 35mm and 16mm work. Built-in gears and cams function automatically to provide proper speed and action when either 35mm or 16mm mechanism is slipped into place.

Shuttles are designed with fixed pilot-pin registration. The principle underlying this design is based on pilot pins which are fixed in their relationship to the aperture. With this construction, all movement is confined to the film, a condition that is vital for no-play, rock-steady pictures on the screen. This is essential for double exposure and matte work. A spring-loaded pressure plate accommodates three films without adjustment. Loading of film is facilitated by a latched lift button that relieves plate pressure when the shuttle is being threaded.

Shuttles are constructed so the aperture can be changed quickly by removing four screws from the front, making it unnecessary to strip down the shuttle. Various apertures are available for use on the projector head and camera. Included are: full-silent aperture, sound (Academy) aperture, split-half-way screen aperture, horizontal half-split aperture and four-way-split aperture. The latter provides hard or sharp-edge split.

Each shuttle is machined from a solid steel block and has a cast steel yoke with hardened faces that engage the cams. The entire camshaft is cut from one piece of steel and it includes three cams and a worm. One heart cam comes into play when the 35mm shuttle is inserted, another heart cam performs a similar function when the 16mm shuttle is used. Shuttle forks are so placed that they pick up action from the proper heart cams whenever the 35mm or 16mm mechanisms are inserted.

In operation, the action is as follows: Barrel cam strips the film off the fixed locating pins and onto the carrier pins activated by the heart cam — this advances the film one frame. Next, the barrel cam comes into play again to strip the film from the carrier pins and



Fig. 4. Operator mounting the projector by sliding it into dovetail plate on frame of the printer.

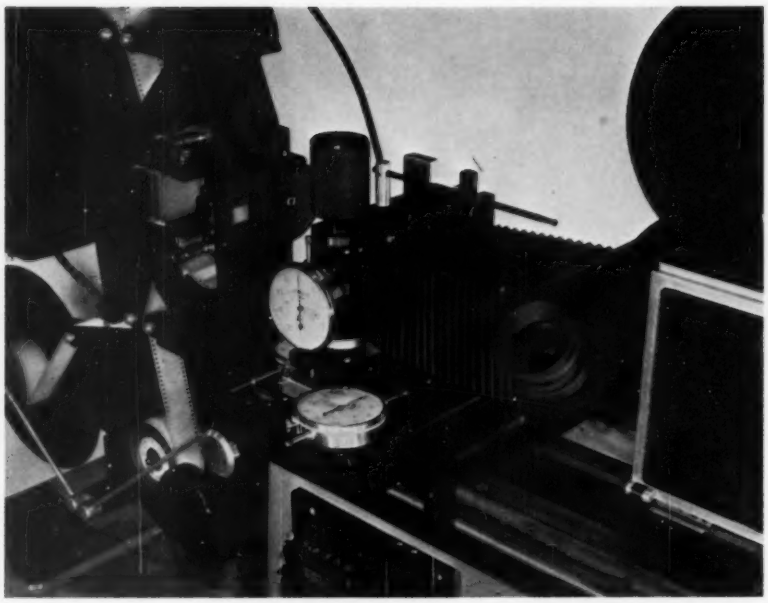


Fig. 5. Close-up of projector, camera bellows and superimposure eyepiece, showing knurled control knobs and gauges for facilitating precise adjustments.

place it on the fixed locating pins. During this cycle the heart cam brings back the carrier pins and the action is repeated. Motive power for the sprockets is delivered by the camshaft worm.

The fixed-pin shuttle design eliminates the need for moving pins — it is the only method so far reported satisfactory for high precision process work. The new shuttle mechanism is limited by design to speeds below 700 rpm.

Projector

The projector head is mounted on a finely controlled compound movement, and two dial indicators are provided for positioning. This compound action assures accurate offset settings such as are used for off-center zooms (trucks). The design also facilitates fine alignment and makes simple changing between 35mm and 16mm. Four spindles each accommodate one 1000-ft reel of film.

The Oxberry compound movement can handle push-offs in either direction, up or down, east or west. The advantage of this action is fully appreciated when explained with a typical example. If the projector head moves 0.001 in., this equals 0.001-in. movement of the camera. When push-offs, drop-shadow or alignment jobs are accomplished with the lens, the adjustment is twice as critical. In such case, a lens movement of 0.001 in. is equivalent to 0.002 in. on the camera.

On this printer, one projector head (Fig. 4) accommodates 35mm and 16mm films. Shuttle and sprocket assemblies are interchanged in less than three minutes with no need for realignment of optical centers. All compensating devices for converting the projector head from 35mm to 16mm are built into the unit. Slots are provided for standard glass filters and a frame counter is built in for single-frame adjustments.

Two high-speed rewind motors operate at 600 rpm in forward or reverse direction, independently for projection head and camera. These units by-pass the stop-motion clutch and the variable-speed drive. This permits the operator to pass footage on either projector or camera independently or in conjunction with shooting-speed drive, in any combination including forward and reverse.

An air-cooled lamphouse attached to the projector head is built to receive bulbs ranging in size from 300 to 1000 w. A constant-voltage transformer in the base compensates for line voltage variations. Controls and a voltage indicator on the panel permit accurate settings for any desired light output.

Instead of the standard condenser lenses in the lamphouse the printer incorporates an achromatic system for maximum light efficiency. It is corrected for spherical, color and coma aberrations. This permits straight-through printing without a diffusing glass at 1 to 1 ratio. The achromatic lens installation delivers 22,000 ft-c when using a 500-w lamp. This is 30 to 50% more light output than is possible with the standard condenser lens system.

A traveling matte carrier is attached in front of the projection shuttle for wipes and other special effects. The unit has a single-frame advancement which is manually operated. Master sets of special-effect mattes are supplied when ordered by the customer.

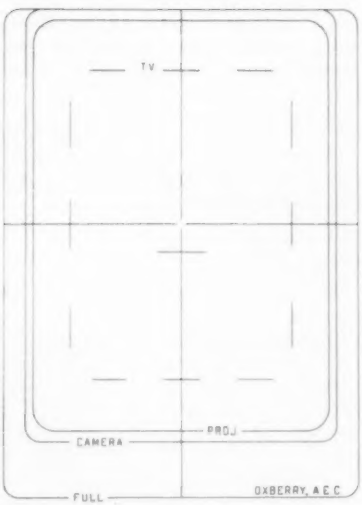


Fig. 6. Drawing of reticle gauge markings.

Camera

Superimposure Device: The gauge plate in this unit has a ground-glass reticle mounted in a steel dovetail slide having two film registration pins (Fig. 5). A compound adjustment on the gauge plate provides for realignment when necessary. The superfine ground glass is precisely mounted and aligned to match the film registration pins in the shuttle. In order to match the film plane, the eye picks up the image on the top ground-glass side of the reticle plate.

The design compensates for the index factor of the glass in order to place the

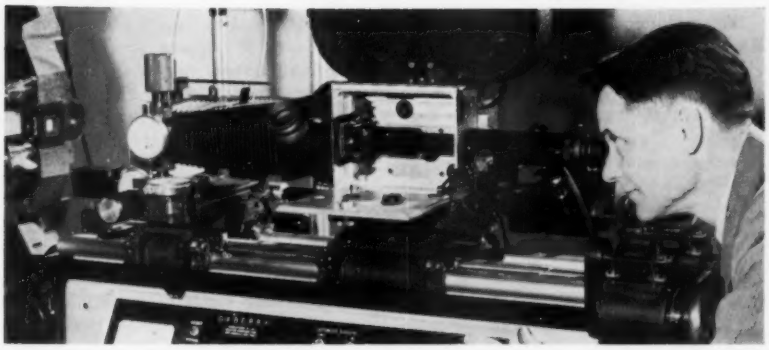


Fig. 7. View of operator sighting through the camera with a scope; sprocket assembly and cutout back pressure plate have been removed.

film at the proper film plane. This new feature permits a piece of film, such as a previously exposed or developed frame, to be placed on the registration pins over the ground glass for clearer image. The operator views through the film first and then through the ground-glass field markings which are fixed in relation to the pins.

Markings on the reticle are essentially a series of rectangles. The progression from largest to smallest is as follows: (1) silent aperture, (2) camera sound aperture, (3) 35mm sound projection aperture, (4) dotted 25% TV cutoff aperture for 35mm, (5) 16mm camera aperture, (6) 16mm projection aperture and, (7) dotted 25% TV cutoff aperture for 16mm. Reticles also have horizontal and vertical cross-lines common to all rectangles. A short tick-line represents the center of silent 35mm or 16mm film (Fig. 6).

One may easily view an entire film frame with each etched rectangle; lines are 0.002 in. thick and are clearly apparent. The superimposure ground-glass gauge is mounted firmly on the camera body to assure maximum stability. Only the eyepiece is attached to the hinged section.

Viewfinder: The camera incorporates a viewfinder which permits the operator to observe the film when checking action and composing. Since the printer may be run at one-half live-action speed, the viewing on the printer is comparable to screening film on an editor. The projector head has a hand control for advancing the film and this permits adjustment of frames while viewing.

Special Critical Viewing: For supercritical lineup work with traveling matte or alignment checking, one may sight directly through shuttle from rear of camera (Fig. 7). The basic design provides for removal of the sprocket assembly as well as a cutout back pressure plate from the shuttle.

Buckle Switch: A special buckle switch in the camera housing provides complete protection against jamming or other improper operation of the film transport mechanism. Should a jam occur, the printer automatically stops and a white signal light on the control panel flashes to indicate the trouble.

Tilt Mechanism: The camera is mounted on a built-in tilting cradle and is accurately positioned by means of a control knob and dial indicator. This permits scenes to be straightened and allows the operator to do precision alignment work. This feature, used in conjunction with projector and camera adjustments, permits a wide latitude of corrective film positioning.

Light Meter

This portable instrument is mounted between the projector head and camera and is readily accessible for light readings with special probes. Probe accessories include: (1) one shuttle blank probe holder for camera readings for either 35mm or 16mm, (2) two probe holders to fit the projection aperture, one for 35mm and one for 16mm. The light meter has three foot-candle scales, 0–20, 0–50 and 0–500.

Lenses

Two lenses are recommended as standard equipment and they are readily interchanged in the mount. One is a 4-in. Ektar $f/4.5$ which is best suited for zoom work. The other lens is a 103mm $f/2.8$ printing Ektar which is designed for 1-to-1 work. An accessory 90mm lens is available as optional equipment. It is designed for 16mm to 35mm film blow-up work and for 35mm to 16mm reductions.

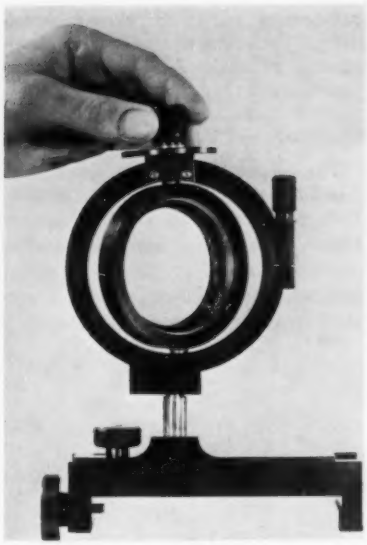


Fig. 8. Close-up of flip-lens device.

For work with squeezed 35mm to unsqueezed 35mm, a special CinemaScope lens is supplied, when specified by the customer. This is a special CinemaScope lens that is designed to fit the Oxberry mount.

A special flip attachment is attached between the lens and projector head and is designed so the lens may be positioned at any angle for vertical or horizontal flips (Fig. 8).

The lens mount is designed with three castings which are precision-machined. The mount rides on two ground shafts and is heavily spring-loaded. Lead screw movement is threaded 40 turns/in. and adjustments are made with a knurled knob which provides micrometer action. Vertical movement of the lens mount is essentially the same except that it has

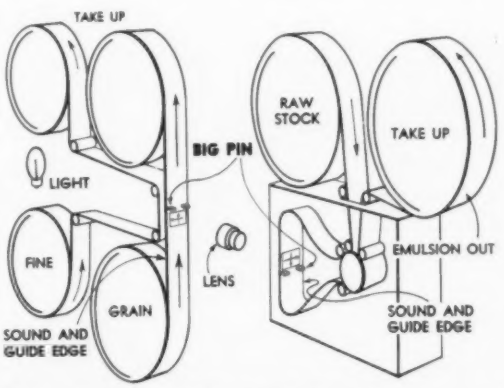


Fig. 9. Depiction of film travel through camera and projector.

ball-bearing rollers for extreme sensitivity. The two movements make it possible to obtain very accurate zero positioning.

Magazines and Take-up

The printer is built to receive altered S-series Mitchell magazines, 400 ft, 1000 ft and bipack, either 35mm or 16mm. The 16mm film size is symmetrically placed in the center of the modified 35mm magazines. All magazines are easily attached and removed.

This unique Oxberry mechanism utilizes an electrical-mechanical system that eliminates the usual problems encountered with spring-belt take-ups. A torque motor is mounted on each of the four spindles. One pair handles forward movement and the other pair handles reverse. The change of operating conditions is accomplished automatically when the printer is shifted from forward to reverse or vice versa. The nondriving pair of motors is electrically energized to provide braking action to keep the film under proper tension. The take-up accommodates 400-ft, 1000-ft or bipack magazines for 35mm or 16mm film. Tension control may be adjusted to provide proper torque. Figure 9 shows how the film travels through the camera and projector.

It is expected that the new concepts employed in the optical, mechanical and electrical systems of this printer, the new features added to it and the major improvements made in its other components will provide greater precision, an increased range of application, and simplified setup and shooting procedures.

motion-picture standards

Proposed American Standards

Two Proposed American Standards, PH22.31, Motion-Picture Safety Film, and PH22.113, 16mm Flutter Test Film, Magnetic Type, are published here for a three-month period of trial and comment.

PH22.31 was initiated by the Film Dimensions Committee as a revision of Z22.31-1946, Motion-Picture Safety Film. Since this standard referred to Z38.3.1-1943, American Standard Definition of Safety Photographic Film, which was replaced by PH1.25-1956, it was thought desirable to revise Z22.31-1946. Published here is a second draft; the first was objected to on the grounds that films having widths greater than 35mm should be included and that it was indefinite as to whether the standard applied to the use or the manufacture of motion-picture film. It should be noted that films having widths greater than 16mm have been excluded for reasons given in the notes of the standard.

PH22.113 is a result of the efforts of the Magnetic Recording Subcommittee which undertook the responsibility of specifying a magnetic sound test film for use in determining the presence of flutter in 16mm magnetic sound reproducers. Work on this standard began in 1952 and after many modifications and comments concerning dimensions, flutter content and film compliance, this version was approved by the members of the Sound and Standards Committees.

All comments should be sent to J. Howard Schumacher, Staff Engineer, prior to May 15, 1958. If no adverse comments are received, the proposals will then be submitted to ASA Sectional Committee PH22 for further processing as American Standards.—*J.H.S.*

Proposed American Standard

Motion-Picture Safety Film

PH22.31

Rev. Z22.31-1946

1. Scope

1.1 This standard specifies the American Standard defining safety photographic film and the motion-picture films which shall comply with this standard.

2. Safety Film

2.1 The term "safety film" as applied to motion-picture film shall comply with American Standard PH1.25-1956, Definition of Safety Photographic Film, or the latest revision thereof approved by the American Standards Association, Incorporated.

2.2 All motion-picture and magnetic film, regardless of width, shall be manufactured so as to meet the definition of safety photographic film.

2.3 Only safety film shall be made available for and used in 16mm and 8mm motion-picture cameras and projectors.

NOTES

1. 35mm nitrate motion-picture film is no longer manufactured in the U.S. However, there are existing nitrate films still in use or in storage and there are others existing or of future manufacture which may be imported. There is no intent in this standard to limit the use of such 35mm nitrate films, but by designating them as "nonstandard" it is intended to emphasize that the hazard involved in their handling requires the observance of adequate precautions and safeguards. (See "Standards of the National Board of Fire Underwriters for Storage and Handling of Cellulose Nitrate Motion Picture Film as Recommended by the National Fire Protection Association," NBFU Pamphlet No. 40, November 1953.)

2. Nitrate film, because of its attendant fire hazards, has never been manufactured in the U.S. in the 16mm and 8mm widths since these are traditionally for amateur and nontheatrical use. However, small quantities of nitrate film may be in existence as a result of foreign import or from slitting operations of certain intermediate laboratory processing films. The purpose of ¶2.3 is therefore to classify and designate as nonstandard the handling or use of all such film.

NOT APPROVED

Proposed American Standard

16mm Flutter Test Film, Magnetic Type

PH22.113

1. Scope

This standard specifies a 3000 cps magnetic sound test film for use in determining the presence of flutter in 16mm magnetic sound reproducers.

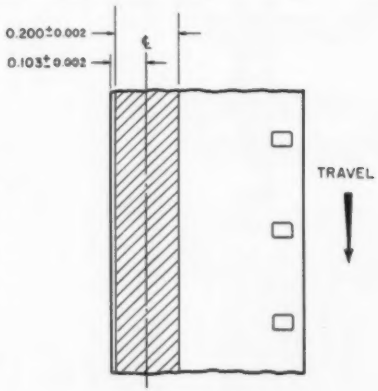
2. Test Film

2.1 The test film shall have an originally recorded, 200-mil width, magnetic sound record, the location and dimensions to be in accordance with American Standard PH22.97-1956, 200-Mil Magnetic Sound Record on 16mm Film, Perforated One Edge, or the latest revision thereof approved by the American Standards Association, Incorporated, and as shown in the drawing.

2.2 The recorded frequency shall be 3000 ± 25 cps with a film rate of 24 perforations per second (approximately 36 ft per minute).

2.3 The recording shall be made at 100% modulation level with a tolerance of + 0 — 2 db. 100% modulation is defined as the recording head current at which 3% total harmonic distortion occurs at a signal frequency of 1000 cps.

2.4 The total rms flutter of the sound recorder shall not exceed 0.1% and the flutter amplitude, at any single flutter rate, shall not exceed 0.05% (as defined in American Standard Z57.1-1954, Method of Determining Flutter Content of Sound Recorders and Reproducers, or the latest revision thereof approved by the American Standards Association, Incorporated).



3. Film Stock

The film stock shall be of the low-shrinkage safety type, cut and perforated in accordance with American Standard PH22.12-1953, Dimensions for 16mm Film, Perforated One Edge, or the latest revision thereof approved by the American Standards Association, Incorporated.

4. Length of Film

The film shall be supplied in 100-ft and 400-ft lengths.

5. Identification

The film shall have identification markings at both ends.

APPENDIX

(This Appendix is not a part of Proposed American Standard 16mm Flutter Test Film, Magnetic Type, PH22.113, but is included to facilitate its use.)

It is recognized that there are certain desirable features in a test film of this kind which will simplify its use in measuring flutter. Because of the variety of flutter measuring meters, one such feature is reasonable uniformity of the reproduce level throughout the length of the test film. It is recommended that the long term variations measurable by a VU type meter shall be less than ± 1 db from the initial level specified in ¶2.3.

Reproduce level variations of short term duration, as for example those resulting from drop-outs, cause some difficulty in the use of this film but these do not lend themselves today to precise manufacturing specifications. It is recommended that the manufacturer exercise the maximum care to minimize these variations.

NOT APPROVED

news and reports

PAPERS PROGRAM
83d Convention, April 21–26

The prospective arrangement of subjects and sessions will be set forth in a postal announcement folder being mailed to all Members late this month. Also in that folder will be the Hotel Reservation card and the SMPTE Advance Registration card and data.

Listed below are some subjects planned for the Program according to information ahead of deadline from *Herb Farmer*, Program Chairman:

"Use of Plastics in Motion-Picture Studios," a symposium and panel discussion with assistance from the Society of Plastics Engineers, with Dr. Herbert Meyer of the Motion Picture Research Council as moderator.

"New Lenses for TV and Motion-Picture Production"

"Economic Aspects of TV Film Production in Color"

"Recent Advances in Film Laboratory Equipment Design"

"An Automatic 16mm Film Processor"

"Automatic Densitometry"

"Factors Contributing to Steadiness of 16mm Prints"

"Dirt Control and Film Handling Operations"

"16mm Ektachrome Commercial Film"

"Advances in Review Room Equipment and Techniques"

"Language Translation by Machine"

"Developments in Monochrome and Color Video Tape Recording"

A group of *closed-circuit TV* papers already includes:

"Industry Standardization Effort"

"Aspect Ratio Treatment at Bartlesville"

"Generating and Processing TV Signals for Narrow-Band Transmission"

"Sensitivity and Speed of TV Camera Tubes"

"Zoom Lenses for Closed-Circuit Television"

Papers on *Television Recording* already include:

"16mm Color Kinerecording for Theater Projection"

"The BRYG System of Photographic Color Projection for Television"

"High-Fidelity Video Recording Using Ultrasonic Light Modulation"

Five Ampex Corp. papers on: Interchangeability of Recordings; Electronic Conversion to Color Recording; Engineering Planning; Electronic Marking and Control for Editing; Timing and Frequency Requirements.

The above are paper subjects which have materialized at an early date.

Members will be better advised by the mailing late this month, then especially by the Advance Program in the *March Journal*. Hotel information is on p. 106.

Convention Equipment Exhibit

John Olsson, Chairman of the Exhibit Committee, reports that within a week after the mailing of brochures and order forms 14 companies had signed up for a total of 17 booths. At this rate the available space should be practically filled by the time this issue appears.

The response from the industry is a clear indication of the interest many manufacturers and suppliers of professional equipment have in using the opportunity presented by an SMPTE convention, especially on the west coast, to show their products in what is for many of them the only forum in existence where such specialized equipment can be shown.

The companies who have already reserved space are:

Animation Equipment Corp., Booth 203
Bell & Howell Co., Booths 218, 220
Birns & Sawyer, Booth 201
Camera Equipment Co., Booth 212
Great Books of the Western World, Booth 109
Herrnfeld Engineering Corp., Booth 118
Houston-Fearless Div., Booth 101
Kling Photo Corp., Booths 204, 206
Magnasync Mfg. Co., Booth 202
Mole-Richardson Co., Booth 217
Producers Service Co., Booth 104
S.O.S. Cinema Supply Corp., Booth 102
Traid Corp., Booth 219
Westrex Corp., Booths 103, 105

A layout of the space and other information appeared on p. 39 of the January *Journal*.

The area in which the exhibit will be held is the same as at the last Convention in Los Angeles, in 1956. Situated next to the auditorium where the technical sessions are held, it is ideal in arrangement and location and assures maximum convenience for exhibitors and viewers. Anyone who still intends to show equipment at this Convention should telegraph John Olsson, c/o Houston-Fearless Div., 11801 W. Olympic Blvd., Los Angeles 64.

1958 Directory for Members

Re-reminder from the January *Journal:*

Does the label on the envelope in which this *Journal* came to you

or the April 1957 *Journal* Part II have an error or inconsistency in your address or listing?

The 1958 Directory is planned to have the same general content and arrangement as the 1957 Directory. Please send corrections and suggestions to Society Headquarters. New members and new addresses are expected to be included if received by March 5 and they will be taken into account as far as feasible during the remainder of March. Suggestions for improving the Directory will be welcome at any time.—*Ed.*

GOOD NEWS!

ARRIFLEX 16 SHIPMENTS STEPPED UP

Many important motion picture producers, cinematographers, and industrial users waited months—even years—for delivery of Arriflex 16 cameras. With the intense demand for this outstanding equipment far in excess of initial production, a long waiting time was unavoidable.

Today, more new buildings, more new machinery, and a growing staff of highly skilled technicians enable the Arri factory to fill orders with increasing speed.

If you want the ultimate in 16mm cinematography, you will, naturally, turn to the Arriflex 16. Its mirror reflex shutter—not a beam splitter—gives you positive through-the-lens focusing and viewing without loss of lens efficiency, eliminates finders and rack-over devices. A registration pin film movement assures rock-steady screen images. You have a choice of electric motor drives for any purpose including synchronization, animation, or time lapse. Sound blimp, 400 ft. magazines, and wide selection of useful accessories, plus many other built-in features make the Arriflex 16 the outstanding all-round cine camera. What's more its weight of only 6½ pounds makes it ideal for hand-held shooting.

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Convention Hotel

Like the last two conventions in Los Angeles, this convention will be held at the Ambassador Hotel. Well located, midway between Hollywood and downtown Los Angeles, the Ambassador has public rooms that are ideally suited and arranged for taking care of our session, exhibit and committee needs. Set among wide lawns and gardens, with a very fine swimming pool, it is also a most attractive spot for members' families to enjoy themselves during the convention.

Rates at the Ambassador are: Single room with bath, $9.00, $11.00, $13.00, $15.00, $17.00, $19.00 per day; double room with bath, $3.00 additional per day in each case; parlor, bedroom and bath, occupied by one person, $27.00, $29.00, $33.00, $35.00; parlor, bedroom and bath, occupied by two persons, $3.00 additional per day in each case. Garden Studios are available with full hotel service and easily accessible to the main building. Rates are: Room with bath, occupied by one person, $17.00, $19.00, $21.00, $23.00 per day; room with bath, occupied by two persons, $3.00 additional per day in each case; room with private sun deck or terrace, occupied by one person, $21.00, $25.00; occupied by two persons, $24.00, $28.00 per day; large living room, bedroom and bath, occupied by one person, $37.00 per day; with large private sun deck, $47.00; occupied by two persons, $3.00 additional in each case.

Reservations can be made with the card included in the postal announcement to all Members or by citing the SMPTE and writing to: Reservation Manager, Ambassador Hotel, 3400 Wilshire Blvd., Los Angeles 5.

Local Arrangements

There is never any lack of things to do at a Hollywood convention. In addition to the Get-Together Luncheon, at which there will be a principal speaker and amenities and levities, and the usual cocktail party, banquet and dance, there will be many other social occasions arranged for convention visitors, including trips to motion-picture and television studios, and an opportunity to visit Disneyland.

Those who are responsible for these arrangements, as well as all other matters to do with making the convention a success, are:

Local Arrangements Chairman — *John W. DuVall*
Exhibits: *John B. Olsson*
Hotel Arrangements: *Dennis F. Godfrey*
Registration: *Lewis Mansfield*
Ladies' Committee Hostess: *Mrs. John W. DuVall*
Hospitality: *Theodore B. Grenier*
Transportation: *Lewis Mansfield*
Banquet: *Sidney Solow*
Luncheon: *Hans de Schulthess*
Projection: *M. Bundy Smith*
Public Address and Recording: *Kenneth Miura and Daniel H. Wiegand*
Publicity: *Marty Waldman*
Membership: *Harry J. Lehman*

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REU-1
rewind w/universal joint and end support to hold up to 5 - 35mm reels.



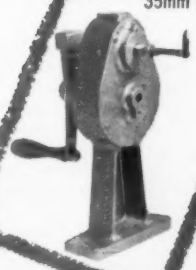
REF-1
friction control rewind w/1 reel shaft 35mm.



RETWC-1
rewind w/16 - 35mm combination tightwind



RE-1
rewind w/1 reel 35mm shaft



SB-1
swivel base attachment for rewind





SP-16 (16mm) spacer
SP-35 (35mm) spacer

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SMPTE at TOA-TESMA-NAC Show



Through the kindly cooperation of the officers of TESMA, our Society was again able recently to demonstrate its service to an important segment of the industry by mounting its traveling display at the 1957 Convention and Trade Show of TOA-TESMA-NAC, which took place November 20–23, 1957, at the Americana Hotel, Miami. The principal emphasis was on the SMPTE test films, which were of special interest to the theatre owners and projector products manufacturers who made up a large part of the attendance.

General interest in the Society's activities was high, and there was considerable local publicity, in which SMPTE shared, about the show. Television news coverage on film, broadcast from a local station, included shots of activity at the SMPTE booth.

Credit for handling the booth and for manning it during the three days of the show with people equipped to deal with inquiries about the Society goes entirely to local members in Miami. Without this support, the opportunity to publicize SMPTE services in this useful fashion could not have been accepted, and the Society is duly grateful for their efforts. Chief among them was C. Henderson Beal, Motion Picture Director in the Radio-TV-Film Department of the University of Miami, who took the entire responsibility for putting on the display in the Society's behalf. In the picture above, Mr. Beal is seen in action at the booth, responding to an inquiry.

Also contributing their time and efforts toward the success of the display were SMPTE members Charles Warner, who made a number of publicity stills of the booth including the picture shown here; David Weiman; David Sperber; Peter Hallinan; and Jay Sedlik. Paul Palumbo shot motion pictures for television coverage; Helene Pardoll was secretary in charge. An interesting record of the event was made in the form of a three-minute motion-picture film, showing the booth and its environs.—*D.C.*

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E. Ray Arn, president of Film Associates, (with more than a decade of experience in continuous film processing) has this to say about his Filmline R-90 processor:*

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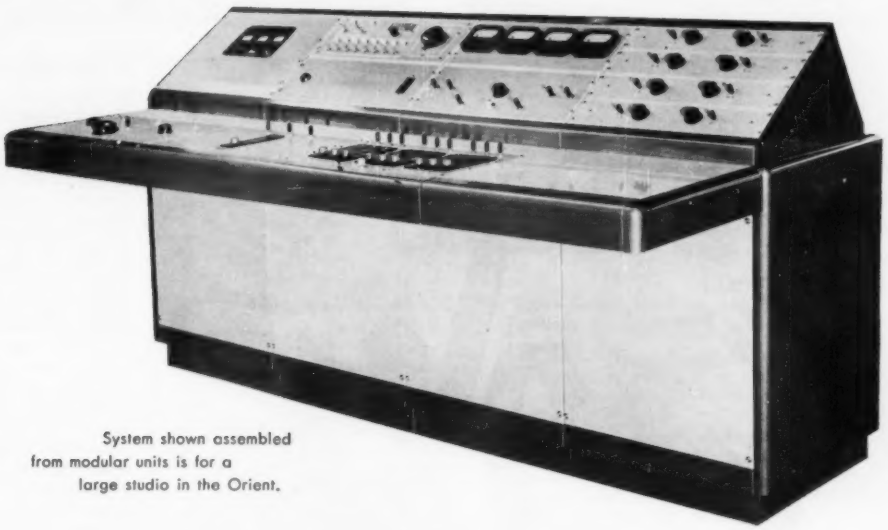
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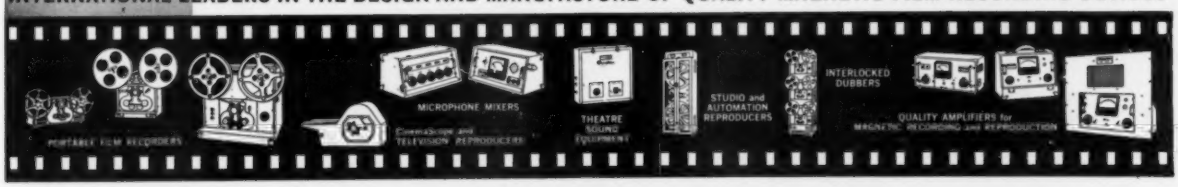
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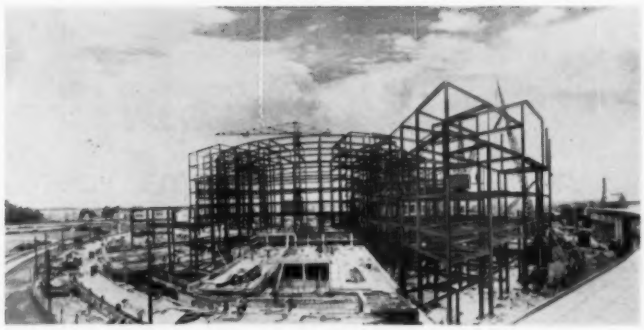
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Education, Industry News

British Broadcasting Corp. has announced plans for a $25 million television center now under construction at Shepherds Bush, London. The announcement was made in connection with commemoration events in honor of BBC's 21st "Birthday." The 9-floor "ring" structure occupies a 13-acre site and encloses a court of about 150 ft in diameter. Production departments will be on the lower floors and offices will occupy the upper stories. (Photos above.)

A series of closed-circuit TV programs sponsored by the Massachusetts Veterinary Assn. in cooperation with Chas. Pfizer & Co., 630 Flushing Ave., Brooklyn 6, N.Y., was a feature of the 1957 Eastern States Exposition held Sept. 14–22 in Springfield, Mass. Thirty-five veterinarians acted as announcers. Subjects covered in the telecasts included a demonstration of the proper method of giving artificial respiration to a cow and various interviews on subjects connected with services within the field of veterinary medicine, such as training dogs for military duty. The programs originated in the Youth Building on the exposition grounds and were sent over 4000 ft of coaxial cable to TV sets throughout the grounds.

The Eighth Annual International Symposia of the Microwave Research Institute of the Polytechnic Institute of Brooklyn will be held April 8–10 at the Institute. Under the general subject of waveguides, papers will be presented on such subjects as Fundamental Progress reports; Mode Theories; Noise Theories; Linear and Nonlinear Theories of Space Charge Waves in Open and Closed Systems; and Plasma Waves. The Symposium is open to all interested persons. Further information can be obtained from the Microwave Research Institute, 55 Johnson St., Brooklyn 1.

An experiment having wide implications in community education is now underway in the Chelsea district of New York. A total of 608 low-income apartments in Manhattan's lower West side are now linked by a closed-circuit TV system with educational and entertainment programs broadcast to schools, settlement houses and homes from seven originating points.

The overall aim of the project is that of raising the cultural level of the community and bringing about increased awareness of

civic responsibilities and privileges. It is financed by a three-year grant from the Fund for the Advancement of Education. Morning programs will be seen by pupils in participating schools and the same programs can be seen by their parents, many of whom do not speak English. Evening programs will emphasize adult education with programs planned to bring about better community relations.

Broadcasts will include a variety of subjects such as English, music, science, health, nutrition and hygiene, civics and other subjects related to community activities.

Another experiment in educational closed-circuit TV begun last September at Port Chester, N.Y., High School has enjoyed good reports in relation to both pupils and teachers. The school principal, Robert Zimmerman, has noted that, except for budget limitations, he would favor extending the system to junior high and elementary schools. The closed-circuit system was installed by General Precision Laboratory. It is comprised of twin cameras and a receiver in one classroom and monitor screens which provide larger-than-life images in two remote classrooms.

Plans for a new $10 million United Engineering Center to be erected on United Nations Plaza, New York, have been announced. The new building will serve as headquarters for 16 National Engineering Societies with a total membership of about 300,000 engineers. It will replace the 50-year-old Engineering Societies building at 29 W. 39 St., New York. The new Center is planned as a 20-story tower surrounded by lower structures, containing, in all, about 250,000 sq ft of floor space. Among other facilities it will house the Engineering Societies Library and exhibition space. An engineering Hall of Fame to perpetuate the contributions of distinguished engineers to modern civilization is also under consideration.

Founder Societies whose headquarters will be in the new building are: American Society of Civil Engineers; American Institute of Mining, Metallurgical and Petroleum Engineers; American Society of Mechanical Engineers; American Institute of Electrical Engineers; and American Institute of Chemical Engineers. Eleven associated societies, including SMPTE, are also expected to have headquarters in the new building.

Five bulletins on Television in Teacher Education have been issued as part of a series prepared by the Subcommittee on Television in Teacher Education of the American Association of Colleges for Teacher Education. Subjects are: Closed-Circuit TV Installations in Teacher Education Institutions; Credit Courses Offered by Broadcast TV in AACTE Institutions — Fall, 1956; Uses of TV in Schools and Colleges; Points of View Regarding TV in Education; Present and Anticipated Utilization of Commercial Broadcast Facilities and Programs by 189 Teacher Education Institutions in the United States. Chairman of the Subcommittee is E. D. Partridge, President, New Jersey State Teachers College, Montclair, N.J.

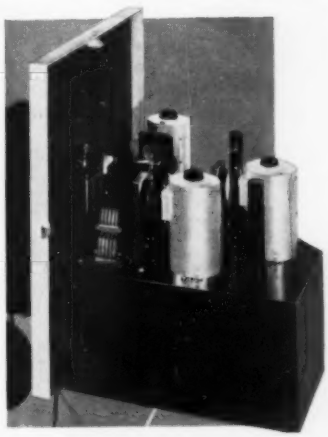
An educational program aimed at improving both the number and quality of physics courses in high schools and colleges in the United States is being conducted by the American Institute of Physics in collaboration with the American Association of Physics Teachers and the American Physical Society. The program has the support of the Fund for the Advancement of Education and the National Science Foundation. Among the specific goals is the evaluation of the feasibility of teaching physics to large numbers of students by means of television and color motion pictures.

The 10th Annual Conference on Electrical Techniques in Medicine and Biology was held Nov. 6–8 in Boston, Mass. The meeting was sponsored by the Instrument Society of America, American Institute of Electrical Engineers, Boston Chapter of the IRE Professional Group on Medical Electronics and the Medical Physics Group of Boston. Three morning scientific discussions and one evening panel discussion were held. Afternoon sessions included trips to nearby laboratories. A paper presented during a session on Instrumentation for Circulation Research described the radioisotope recording of rapid transients in blood flow. The method involves the use of a 35mm film in a high-speed camera. The film can then be played back at a slow speed for observation of the recorded data.

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current literature



The Editors present for convenient reference a list of articles dealing with subjects cognate to motion-picture engineering published in a number of selected journals. Photostatic or microfilm copies of articles in magazines that are available may be obtained from The Library of Congress, Washington, D.C., or from the New York Public Library, New York, N.Y., at prevailing rates.

American Cinematographer vol. 38, Sept. 1957
"Hear Me Good" Shot in Straight Continuity (p. 572) *A. E. Gavin*
Photomacrographic Study of Turkey Egg Incubation (p. 574) *R. W. Wagner*
8mm Comes of Age (p. 590) *J. Forbes*

vol. 38, Oct. 1957
The Cinematographer's Place in TV (p. 628) *H. Mohr*
Use and Abuse of the Zoom Lens (p. 652) *J. V. Mascelli*
Realism in Real Sets and Locations (p. 650) *W. Strenge*
Putting "Interest-Value" into Business Films (p. 658) *W. G. Campbell*
Special Photographic Effects in Motion Pictures (p. 662) *R. Kellogg* and *L. B. Abbott*
Filming for Educational Television (p. 666) *K. B. Lohmann*
University Students Produce Religious TV Films (p. 667)
Mounting the Camera for Improved Pictorial Effects (p. 668) *R. N. Martin*
Preparing the Narration (p. 669)

vol. 38, Nov. 1957
Producing Low-budget TV Spots (p. 724) *E. I. Bergman*
Problems with Light Reflections (p. 728) *R. Zeper*
Portable Lighting Equipment Sparks Trend toward More Location Filming (p. 732) *J. V. Mascelli*

vol. 38, Dec. 1957
The Technique of Follow-Focus (p. 788) *J. V. Mascelli*
Color from B & W Films for Television (p. 791) *A. Rowan*
Subway Filming Poses Problems in Lighting and Photography (p. 796) *D. Darnel*
Norwood Introduces New, Improved Exposure Meter (p. 798)
New Table-top Film Processor (p. 799)
Now You Can Shoot Color Anywhere (p. 802) *G. W. Cushman*

Bell Laboratories Record vol. 35, Dec. 1957
Simulating Sharpness in Color Television (p. 481) *M. W. Baldwin*

British Kinematography vol. 31, Aug. 1957
Colour Television in Practice (p. 31) *B. Somes-Charlton*
The B.B.C. Film Library (p. 41) *A. E. Davis*
Picture Areas of Motion Picture Films for Television (p. 43)

vol. 31, Sept. 1957
Transistors for Audio-Frequency Amplifiers (p. 59) *D. D. Jones* and *S. Welldon*

vol. 31, Oct. 1957
A Review of Television Recording 1946–1956 (p. 87) *L. C. Jesty*

vol. 31, Nov. 1957
A New Approach to Telerecording (p. 119) *A. E. Sarson* and *P. B. Stock*

vol. 31, Dec. 1957
Illuminated Borders to Picture Screens (p. 147) *J. J. Balder*

Institution of Electrical Engineers, Proc.
vol. 104. Part B. Sept. 1957
The "Stereosonic" Recording and Reproducing System (p. 417) *H. A. M. Clark, G. F. Dutton* and *P. B. Vanderlyn*

International Photographer vol. 29, Oct. 1957
Cinemiracle (p. 5)
High Speed Photography (p. 15) *G. Doughty*

International Projectionist vol. 32, Sept. 1957
TV Projection and the Schmidt System (p. 5) *R. MacLeod*
The Release Print Problem of Standard Markings (p. 8) *J. Holt*
Variable-Area vs. Variable Density (p. 11) *J. G. Frayne* and *R. A. Mitchell*
Paramount's Telemeter Drive (p. 12)

vol. 32, Oct. 1957
The Care and Cleaning of Screens (p. 7) *R. A. Mitchell*
Factors in Choice of Proper Lamp and Carbon Trim (p. 12) *J. Holt*
Selection of Replacement Equipment in Army and Air Force Theatres (p. 16) *W. D. Shepard*

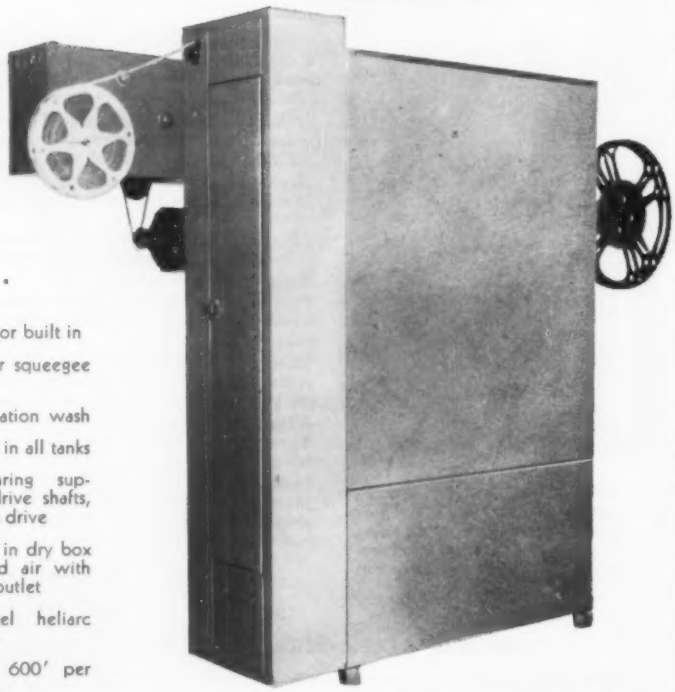
vol. 32, Nov. 1957
Projection with High-Speed Intermittents (p. 7) *R. A. Mitchell*
Panavision Enters Independent Production (p. 11)
From the British Viewpoint (projection lamps) (p. 12) *R. H. Cricks*
Planning Modern Projection Rooms (p. 14) *H. Tuemmel*
A Few Aspects on Obtaining the Best Screen Image (p. 16) *J. Holt*

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vol. 32, Dec. 1957

Side-Weaving: A Common Defect of Projection (p. 7) R. A. Mitchell

Electrical Changeovers for English Projectors (p. 14) A. Buckley

Closed-Circuit TV System and its Practical Applications (p. 19) M. A. Mayers and R. D. Chipp

Journal of the Audio Engineering Society vol. 5, Jan. 1957

Coincident Sound for Home Movies Provided by Tape Recorders (p. 36) *J. N. Whitaker*

A Survey of Factors Limiting the Performance of Magnetic Recording Systems (p. 42) *E. D. Daniel, P. E. Axon,* and *W. T. Frost*

Journal of The Franklin Institute vol. 265, Jan. 1958

Experiments in Television over Telephone Cable Facilities (p. 1) *C. R. Kraus*

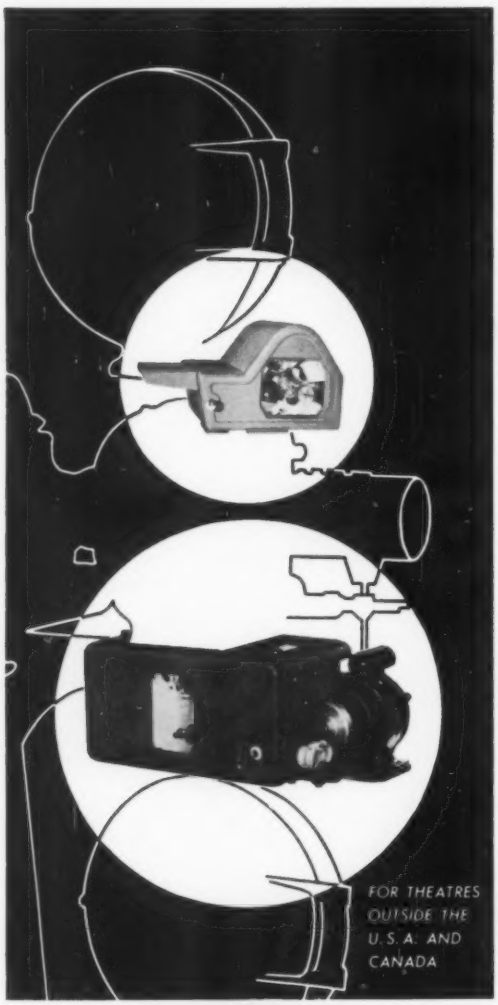
Kinematograph Weekly vol. 484, Sept. 5, 1957

This is Expansion Era in Australia—Given the Films (p. 67) *E. Turnbull*

The Fertile Field of Co-Production (Italy) (p. 94) *E. Monaco*

A Small Land, but Cinema-Conscious (Israel) (p. 103) *Y. Parness*

World Federation is Doing Vital Work (p. 120) *E. Lindgren*



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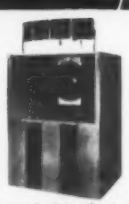
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Obituary



Professor Freeman H. Brown, 59 years old, Director of the Photographic Laboratory of the University of Wisconsin Extension Division and Chairman of The Department of Photography, died on December 1, 1957, after a short illness.

Professor Brown had been with the Extension Division for 26 years. The formative years of the Photographic Laboratory are a tribute to his painstaking efforts to keep the University abreast of new developments and techniques in the photographic field. Under his quiet but vital leadership his department built a firm tradition of technical excellence and an outstanding record of public service.

Professor Brown was a man of ideas. He was particularly fond of, and adept at, planning and designing new equipment to fill unusual University needs. He was an orderly man who approached a photographic problem with sound preplanning and organization.

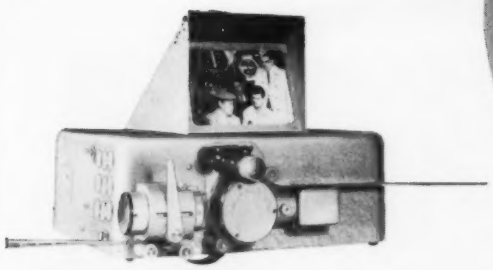
He was responsible for initiating and bringing the University of Wisconsin to the forefront in the production of educational motion pictures. One of his first productions, *The Judy Diary* series in 1932 for the Wisconsin State Board of Health, is still in active distribution. He was most interested in lighting, sound recording techniques and acoustics — continually striving to improve and perfect equipment and techniques in the 16mm field. More recently he was involved in experimental work with high-speed photography, materially aiding research in engineering and other fields.

He was trained as an electrical engineer and a teacher. He had a wide range of technical knowledge combined with an insatiable, penetrating curiosity as to how a thing worked, why it worked, and where it could be improved. He combined his technical talents with an attitude of patience and kindliness that affected everyone around him. His students were at ease with him — but also inspired, for he was creative as well as efficient in his teaching.

Professor Freeman Brown will be missed. His staff at the Photographic Laboratory, The University, his host of friends all over the United States will always remember him as a man not only dedicated to his work in public service — but a man well worth knowing.—*Walter J. Meives.*

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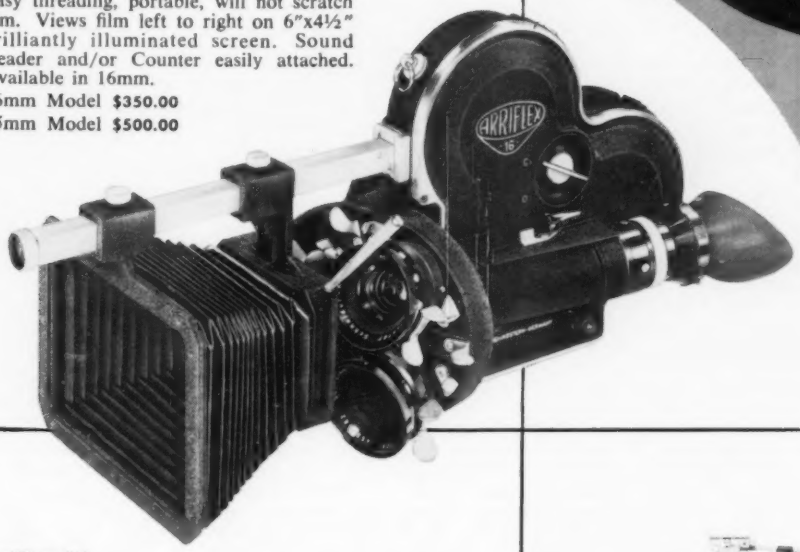
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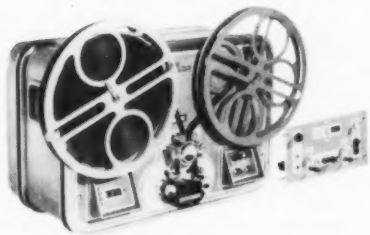
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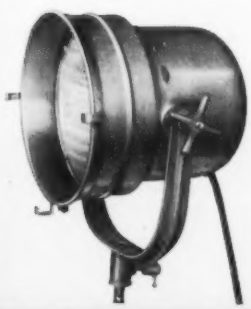
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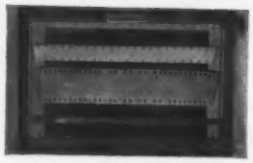
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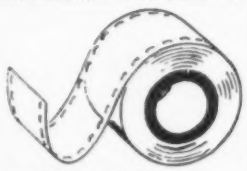


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At the Chicago Section Regional Meeting at Ames, Iowa: left to right—Dr. Warren Boast, Administrative Assistant at Iowa State College; Kenneth M. Mason, Chairman, Chicago Section; Dr. M. Coover, Dean of Iowa State Engineering Dept.; R. Patterson, Engineering Administration Staff, Iowa State College; Geo. W. Colburn, SMPTE Treasurer.

Chicago Section Regional Meeting

In keeping with the usual standards and tradition of the Chicago Section Regional Meetings, the 1957 session in Ames, Iowa, was a great success. The meeting was held on Friday and Saturday, November 8 and 9, at Iowa State College, Ames, Iowa, with the Motion Picture Production, Engineering and Television people in charge of arrangements and acting as hosts. In particular, the thanks of the Section go to Steve Knudsen, Head of the Motion Picture Unit; Ralph Patterson, Staff Administrator in the Engineering Department; and Bill Hughes of the Electrical Engineering Department. Steve Knudsen, by the way, was elected to a two-year term as Manager of the Chicago Section and the announcement was made during the regional meeting.

Twenty-three local members left Chicago on the Chicago & North Western Railroad morning train for the Ames meeting. Accommodations on the train, arranged by Dick Hertel of Kling Studios, were excellent but apparently Dick's authority extended only this far. The train was without an engine and did not leave Chicago station until an hour after scheduled departure time. Helped along by a fifteen mile per hour freight train on the track ahead, our special streamliner managed to lose an additional hour's time, so the somewhat weary but undaunted riders arrived at Ames just in time to break for the cocktail party and dinner. Actually, we were able to get one paper in before dinner so that the afternoon could be called official.

The lateness of arrival and associated inconvenience were more than compensated for by the outstanding program arranged for by Bill Smith, Lakeside Laboratory, Chicago Section Program Chairman, and the boys at Iowa State. Papers were given on Friday afternoon, Friday evening and Saturday morning. Authors and titles follow:

"Radio, Television and Motion Picture Training at Iowa State College" by Dr. Joseph North, Iowa State College.

"TV Station Operation and Activities" by Charles F. Quentin, KRNT-TV.

"Problems of Small Laboratory Operation" by John I. Newell, Western Cine Service.

"Symposium — 16mm Color Internegative/Positive" — Robert and George Colburn, Colburn Laboratory; J. R. Stillings and Neil Rowland, Lakeside Laboratory; W. D. Hedden, Calvin Company.

"The Special Problems Involved in Educational TV Operation" by Don Haahr, WOI-TV.

"A New High-Speed 16mm Reversal Color Camera Film" by Harold Jones, Ansco.

"The Development of the PerceptoScope, a Multi-Function 16mm Projector" by Frank Vanderwall, Perceptual Development Laboratories.

"A Film Production Service on a University Campus" by Steve Knudsen, Iowa State College.

"General Considerations of Lighting for Motion Pictures for Monochrome and Color Television" — Mr. T. Gentry Veal, Eastman Kodak Company.

"The Role of Black and White Film in Color Television" by Bill Hughes, Iowa State College.

As a final treat for the more adventurous members, reserved seat tickets were available for the Iowa State-Nebraska football game which was played in Ames on Saturday afternoon. To make the whole occasion complete, the return train was also several hours late on arrival in Chicago.

It should be mentioned that the meeting facilities provided in the Engineering Auditorium at Iowa State College were among the best that the Chicago Section has ever enjoyed. In addition to the twenty-three Chicago travelers an additional sixty members and guests attended this fine meeting.—*Ken Mason*, Chairman, c/o Eastman Kodak Co., 130 East Randolph Dr., Chicago 1.

The Rochester Section held its October meeting on the 31st at the Dryden Theatre, George Eastman House. There was an attendance of 60 including members of the Optical Society of America who were the guests of the Section. Rudolf Kingslake, Eastman Kodak Co., presented a paper entitled "The Optics of the Lenticular Color Film Process." C. E. Page of Hazeltine Research then read a paper on "An Instantaneous Electronic Color Negative Film Analyzer" for the authors B. D.





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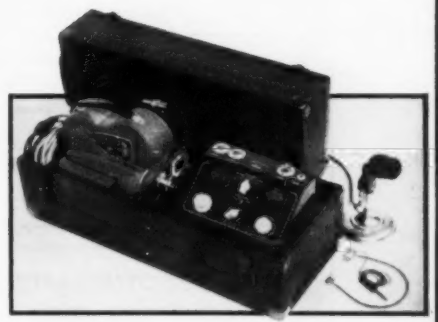
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Loughlin, C. E. Page, W. F. Bailey, C. J. Hirsch, A. J. Miller, and L. Giarraputo. An interesting demonstration by Leonard Giarraputo, Pathe Labs, and a 35mm film followed the reading. Both papers had previously been given at the 82nd Convention. A pre-meeting dinner with the speakers was held at the Treadway Inn.—*A. E. Neumer*, Secretary-Treasurer, c/o Wollensak Optical Co., 850 Hudson Ave., Rochester 5, N.Y.

The Rochester Section held its December 5 meeting at the Rochester Museum of Arts & Sciences. As the final meeting of the calendar year, 70 members and guests of the section were privileged to hear a repeat of a paper by Dr. Fillmore R. Park, National Research Council of Canada. Dr. Park had first presented his paper entitled "Photography and the Geophysical Year" at the 82d Convention in Philadelphia.

Fourteen members including our Sections Vice-President, Ed Stifle, met with the speaker for dinner prior to the meeting. A 16mm short made by IBM illustrating various phases of the Vanguard project rounded out the program.—*A. E. Neumer*, Secretary-Treasurer, c/o Wollensak Optical Co., 850 Hudson Ave., Rochester 5, N.Y.

The San Francisco Section took a guided tour through the Curtis-Lloyd Tube Co. plant in Berkeley, Calif., for its December 10 meeting. The methods used in the rebuilding of TV picture tubes was the subject of the tour and Curt Ingram, Rod Liles and Don Bledsoe, all of Curtis-Lloyd, were on hand to conduct the group of 18 through the plant and to answer all questions. All phases of the rebuilding were in

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operation for our inspection. The following steps were shown to the group; (1) Cleaning; (2) Adding glass to neck of tube for new gun; (3) Removing of old screen; (4) Redepositing new screen; (5) Aluminizing by vacuum plating; (6) Welding new gun into neck and cut-off; (7) Evacuating and sealing; (8) Final operating inspection. All were impressed with the great care that is being put into each operation. The Curtis-Lloyd Co. will rebuild any tube from 5 to 30 in.—*Werner H. Ruhl*, Secretary-Treasurer, 415 Molimo Dr., San Francisco.

The Hollywood Section meeting of November 19 was planned and presented by Society members interested in high-speed photography. The meeting, held at the National Broadcasting Co., Hollywood, had an attendance of approximately 300.

The meeting opened with an entertaining short subject followed by a discussion by Stan Gilman of the Missiles System Div. of Lockheed Aircraft Co., on the production of the progress film required under Table 210 of a military contract. Lockheed had produced a 16mm color film showing the steps in producing this required progress film. It outlined the duties of the producer, writer, project engineers, and management. This film was shown at the end of Mr. Gilman's talk.

Derwyn M. Severy, project engineer on Collision Injury Research at the Institute of Transportation Traffic Engineering, UCLA, gave a talk on "Photographic Instrumentation for Collision Injury Research." This was followed by films from cameras making high-speed photographic records from all angles around the point of impact in an automobile collision. It showed how the photographic instrumentation permitted quantitative data regarding the extent of accident injury to be obtained.

Roy L. Wolford, supervisor of photography for Northrop Aircraft Co., discussed the many applications of high-speed motion-picture photography in research and presented a film which showed examples of many such applications. His film illustrated pictures made at frame rates from 200 frames/sec through 7000 frames/sec, and covered many branches of instrumentation photography.—*Robert G. Hufford*, Secretary-Treasurer, c/o Eastman Kodak Co., 6706 Santa Monica Blvd., Hollywood 38.

The Hollywood Section December 10 at the Academy Award Theatre in Los Angeles attracted a gathering of approximately 285.

Roy Leighton of the Lamp Division of General Electric discussed the recent development of a special type collector grid for use in high-wattage incandescent lamps used for motion-picture studio lighting. He discussed the causes and effects of lamp blackening to show the need for such a collector grid to maintain the beam lumen output of such lamps at a high level until filament failure occurs, rather than having to discard such lamps when their lumen output decreases substantially due to lamp blackening. Mr. Leighton had several of these new lamps on hand to show at the meeting. Frank E. Carlson, also of the Lamp Division of General Electric, discussed the evaluation of the performance of these new lamps and the instrumentation that was developed for such evaluations.

Charles J. Hirsch, Executive Vice-President, Hazeltine Research Corp., discussed in detail the instantaneous electronic color film analyzer which this company has developed for color and black-and-white motion-picture timing. This device is especially useful in that it electronically converts the negative image into a positive image and, at the same time, inserts the positive film characteristics so that the timer is able to see a color positive image that should look substantially the way a color print made from the color negative being analyzed would appear. In addition, controls are provided to enable the timer to vary the intensity and the color of the timing lights to alter the balance to give the most pleasing picture, or the effect that the timer is after. The data from these controls may then be employed on the motion picture printer on which the release color positive is made.

This development has been a cooperative project between the Hazeltine Research Corp., and Pathe Laboratories in New York. Leonard Giarraputo, of Pathe, discussed the implementation of this color timing device in the Pathe Laboratories and the training of the color timers to use this aid. He showed two color motion-picture prints, one of which was a "one-light" print, and the second, made from the same negative, that was balanced both for color and density using the instantaneous color film analyzer. These films graphically illustrated the ability of this color television instrument to enable a commercially acceptable first print to be made from the information supplied by this device alone.—*Robert G. Hufford*, Secretary-Treasurer, c/o Eastman Kodak Co., 6706 Santa Monica Blvd., Hollywood 38.



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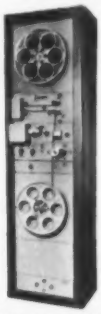
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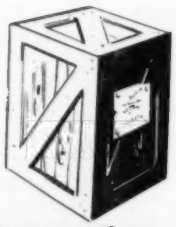


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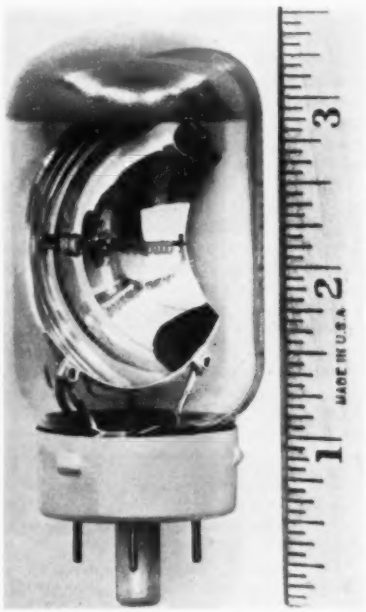
(and developments)

Further information about these items can be obtained direct from the addresses given. As in the case of technical papers, the Society is not responsible for manufacturers' statements, and publication of these items does not constitute endorsement of the products or services.

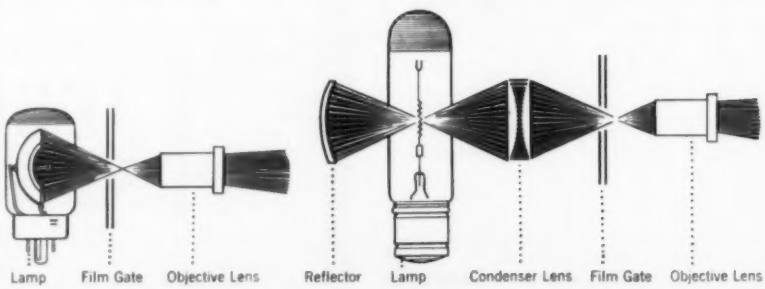
A 10,000-w spotlight lamp announced by the Large Lamp Dept. of General Electric Co., Nela Park, Cleveland 12, employs a new type of tungsten wire screen to reduce blistering and blackening of the bulb. The protective screen, placed between the filament and the glass bulb, eliminates one of the causes of bulb damage by trapping evaporated tungsten before it can reach the glass. Unless a protective device is used, the tungsten evaporating from the high-temperature filament collects on the inner surface of the bulb raising the temperature of the glass to the point where it softens and forms a blister. The new lamp's effective operation is given as approximately 75 hours. The addition of the protective screen is reported to have little effect on the beam pattern and intensity of light. Listed as 10K/G96, the bulb is priced at $98.00.

A ¾-in. 150-w lamp for an 8mm projector, designed to equal a 500-w lamp in screen brightness, has been introduced by Sylvania Electric Products Inc., 1740 Broadway, New York 19. Called the Tru-Flector, the 115-v lamp utilizes a 150-w, specially designed horizontal coiled coil filament which is exactly positioned in relation to a silvered metal mirror within the lamp. The filament is mounted on the same base as that of the company's Tru-Focus horizontal-burning lamp introduced early in 1956 (*Journal*, Apr. 1956, p. 24).

Design of the new lamp is based on the principle used by the designers of the earlier lamp in which a filament is accurately positioned with respect to base and socket. Research leading toward other applications, such as 16mm and 35mm projection, is being carried on in the company's laboratories. The rated average life of the new lamp is 15 hours, with a minimum lumen rating of 95 screen lumens. It burns in a base-down position.



An adaptation of the Weinberg-Watson Kodak Analyst Projector has been introduced by Camera Equipment Co., 315 W. 43 St., New York 36. The original model was described in an article, "A 16mm Projector for Research Films" by S. A. Weinberg, J. S. Watson and G. S. Ramsey in the *Journal* for November 1954, pp. 196–198. An improved model was described by the same authors in the June 1957 *Journal*, pp. 361–363. The adapted model features single frame operation in both forward and reverse. Special construction allows the projector to be stopped on any single frame indefinitely without damage to the film. The projector also features quick transition from continuous to single-frame operation, or vice versa, and remote control of film transport and direction of travel. Designed at the University of Rochester School of Medicine and Dentistry, it is especially applicable in the analysis of sports films, time and motion studies or manufacturing processes. It is priced at $795.00.



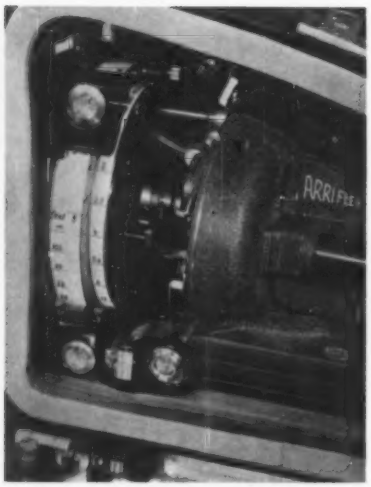


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The 20-year-old Arriflex 35, originally designed as a "system camera" with its potentialities dependent on the addition of accessories, is now applicable to full-scale production use with the addition of the new 1000-ft Arri Blimp. Announcement by the Kling Photo Corp. of 257 Fourth Ave., New York 10, and of 7303 Melrose Ave., Los Angeles, 36, of the new development, stressed the camera's "through-the-lens" focusing and viewing feature which is maintained by the new blimp. The 1000-ft blimp is a further development of the 400-ft blimp, introduced about 4 years ago, which permits use of the Arriflex in soundstage filming.

In operation, the camera's regular d-c handgrip motor is unscrewed and replaced by the standard Arri sychronous-motor drive. The entire unit is then placed inside the blimp, where it rests upon rubber blocks for proper sound insulation. The blimp is designed to accept 1000-ft Mitchell magazines without modification of the magazines, or the use of special tools. A simple adapter is joined to the magazine before placing it in the blimp. A large knob on the front left of the blimp actuates the diaphragm and three knobs, two on the left and right sides of the blimp in front, and one in the rear, control the focusing.

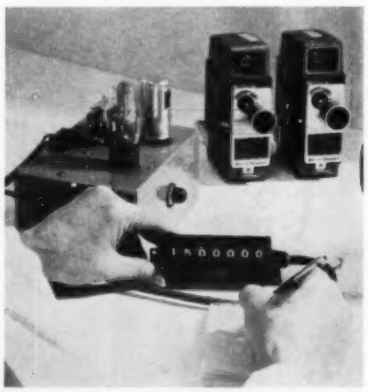
Diaphragm and distance settings are observed on detachable scale bands located behind the soundproof, internally illuminated observation windows on both sides of the blimp. The bands are individually calibrated for each lens and are changed to match the taking lens. Wide-angle lenses can be used.

Other features include two filter stages for standard 3 by 3-in. glass filters; two rear observation windows for the footage counter and tachometer; three doors in addition to the front port to provide access to the blimp interior; and a pulsating pilot light to indicate proper running of the camera. The blimp housing is a magnesium alloy die casting first lined with ten alternating layers of goat-skin, foam plastic and sheet lead, and finally lined with gray corduroy with heavy rubber gaskets surrounding both sides of all doors.

The manufacturers suggest the addition of a buckle switch to be located in the camera head over the lower loop. When the end of the film passes the switch, or in case of film jam, it automatically disconnects the motor, causing an audible signal.

The blimp, complete with accessories but without camera, synchronous motor or magazine, is $3995.00

A device for butt-splicing 16mm and 35mm film with "Magic Mylar Sprocketed Transparent Splicing Tape" has been announced by Florman & Babb, 68 W. 45 St., New York 36. In using the F&B Butt-Splicing Blocks, the film is registered over a set of sprocket pins and cut. The Mylar tape is placed on the block, sticky side up, and the film is lowered onto the tape. Available in four models, the blocks are made of anodized aluminum and are nonmagnetic. Model B-16 for 16mm film is priced at $9.50; Model B-35 for 35mm, at $12.50; Model B-4 for ¼-in. magnetic tape is priced at $6.50; and the BSB combination block for both the films and for tape is priced at $24.50.



The electric eye mechanism of Bell & Howell 290 EE 8mm cameras was subjected to a 90-day endurance test (Aug.–Nov.) during which the cameras functioned 15,000 times each day for a total of 1½ million cycles under maximum strain conditions. The human eye, if subjected to similar conditions, would be permanently damaged in a fraction of the time during which the camera mechanism was tested.

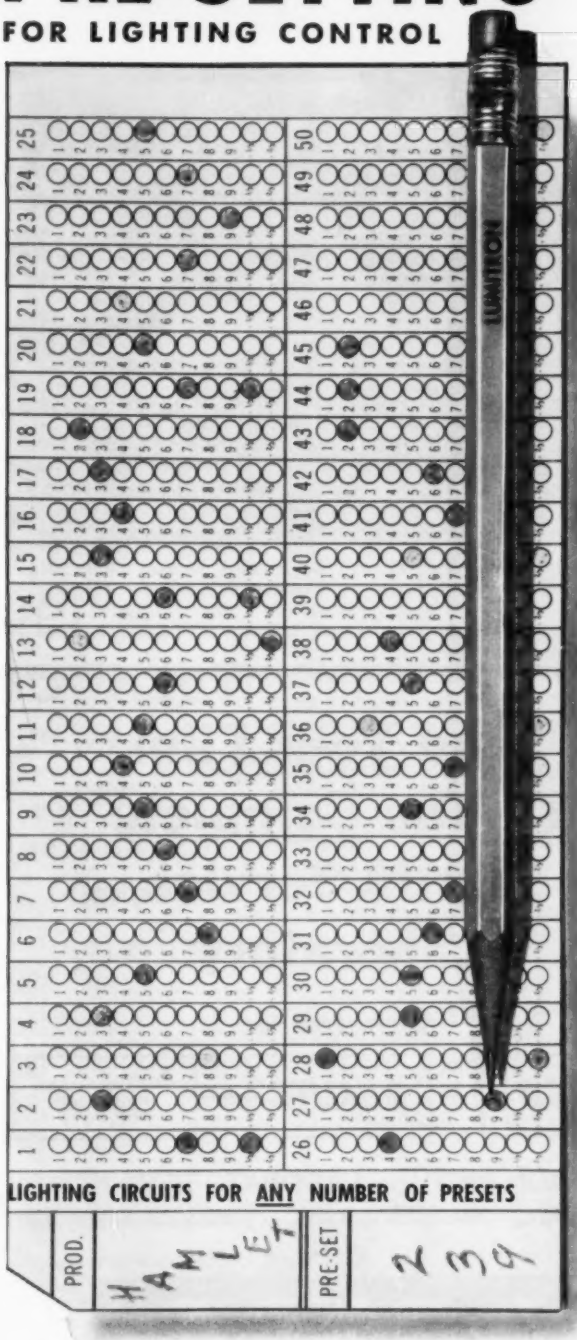
An intermittently flashing light placed a few inches from the cameras causes the irises to adjust from complete darkness to blinding brightness in less than a second. An electronic counter records each light flash. By running the tests continuously the chance of the cells resting and storing up energy is eliminated. Although in terms of actual camera use the testing of the two stock-model cameras has already gone as far as the equivalent of shooting 50 rolls a year for 750 years, engineers now estimate that the cameras may continue to operate in the test for another three years around-the-clock.

The Lanco Electronic Relay designed especially for safe operation of laboratory water baths is a product of Arthur S. LaPine & Co., 6001 South Knox Ave., Chicago 29. A 4-way panel switch provides "fail-safe" load switches. Safety for the water bath operation is ensured by isolation of d-c control from a-c power line. A fact sheet is available from the company upon request.



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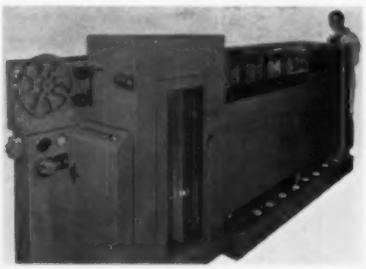
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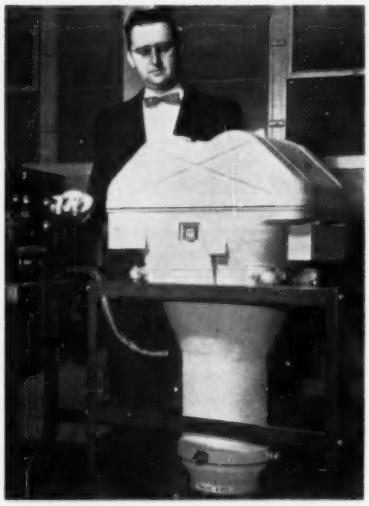
Amplifier Corp. of America, 398 Broadway, New York 13, has designed a self-contained stereophonic tape recorder called Stereo-Magnemite. Protected by a weather-tight aluminum case, the recorder has been designed especially for field use under varying conditions. Three single-speed models are available: 3¾-, 7½- or 15-in./sec. Secondary and primary NAB standards are met by the 7½- and 15-in./sec. models.

The 17-lb recorder measures 8½ by 11 by 10-in. Playback amplifiers are powered by dry-cell flashlight batteries and one B battery. A patented flyball governor on the spring motor is used for constancy tape speed with a reported low flutter of ±0.1% over the full winding cycle. Two clear channels are used for stereophonic recording with independent gain adjustment for each channel. Recordings can be made while the unit is in motion or in varied positions. It is priced at $425.00.



The Filmline R-90 Processor has been announced by Filmline Corp., Milford, Conn. It is a processor for 16mm reversal, negative and positive film at speeds up to 5400 ft/hr at 68 F. A number of features are included as standard equipment such as stainless-steel air squeegees, oil-less air compressor, developer, recirculating pump, replenishing fittings, filter and spray bar. Two 1200-ft daylight magazines are supplied. The feed-in and take-up elevators are designed for continuous operation. A temperature control system with thermostats, called Temp-Guard, provides refrigeration and heating for chemical solutions. The unit operates at 220 v, 60 cycles, single phase, 30 amp. Other voltages are available. It is priced at $14,800.

A 16mm reversal black-and-white film specially prepared for use in tissue culture time-lapse microphotography is manufactured by Gevaert Co. of America, 9109 Sovereign Row, Dallas 35, Tex. An emulsion called Cine Phase 26 has been developed for this special use. The film is priced at $7.50 per 100-ft roll, 16 mm, on daylight-loading spools and the price includes processing by Photographic Laboratories, Inc., 3101 San Jacinto St., Houston 2, Tex. A discussion sheet has been issued by Electro-Mechanical Development Co., 2337 Bissonnet, Houston 5, Tex.



A photographic reconnaissance system that can function at supersonic speeds and at extremely high altitudes has been designed by Fairchild Camera and Instrument Corp., Robbins La., Syosset, L.I., N.Y., for the Convair RB 58, a supersonic bomber which flies at speeds in excess of 1130 miles per hour. The system, contained in a detachable pod which can be interchanged for bombing or electronic countermeasure pod systems, employs seven precision aerial cameras and has an overall weight, including instrumentation, of 998.4 lb and occupies 65 cu ft of space.

A significant new feature of the system is its use of closed-circuit TV to enable the photo-navigator to identify landmarks and targets. Positioning features permit manual adjustment of the line of sight of the TV camera to ± 45° relative azimuth limits and from zero to 90° elevation limits. A narrow or wide optical field of view is provided. The telephoto lens has a 10° field while the alternate lens provides a 40° field. Stabilizing optics are employed to present an image in which the horizon remains horizontal in reference to aircraft.

Three new types of aerial cameras were designed for the system, with negative sizes of 9 by 18-in., 9 by 9-in., and 2¼ by 2¼-in., and designated the KA-27, KA-25 and KA-26, respectively. The KA-27 Reconnaissance Camera, with telephoto lens, shown above, has a Rapidyne shutter with continuously variable effective exposure times up to 1/550 sec, servo-controlled aperture settings from *f*/8.0 to *f*/22, and a lightweight magazine for 500 ft of standard 9½-in. aerial film. It is described as a complete unit requiring only power and input intelligence for operation.

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A newly designed camera control system operates automatically or can be controlled manually. The system provides synchronization so that exposure occurs at the same instant in each camera group. Automatic exposure control selects the proper shutter speed and diaphragm opening for each camera in the system for best results over a wide range of light conditions. Image motion compensation is achieved in the system by matching or synchronizing the film velocity with image speed at the time of exposure.

The cameras can be assembled in the pod in two configurations, a Hi-Lo altitude, or Low altitude, depending upon mission and flight plan. The pod for the Hi-Low system contains three 9 by 18 cameras mounted in a single stablized mount; three 9 by 9 cameras, two mounted in a fixed oblique mount and a third in a prime vertical stabilized mount; and a single $2\frac{1}{4}$ by $2\frac{1}{4}$ camera mounted in a fixed forward oblique mount.

A time index recording sub-system has been designed in conjunction with the aircraft's central recording system and the readout devices used with the ground processing equipment to permit automatic printing of all pertinent correlation data on the photographs.

The system operates with a central data recording system containing a central time standard capable of providing a time base in coded form through which all other data are correlated. The central recording system is capable of recording all physical data required for future interpretation, such as velocity, altitude, earth coordinates, weather conditions and other physical conditions as may be required.

Ground processing equipment capable of automatically reading the recorded time base information at high speeds provides for rapid correlation of individual photographs with associated physical data. Through the use of related titling equipment the film negative can be automatically titled so that the intelligence agency receives photographs with all necessary correlation data printed in English with a minimum of delay. The ground-based processing also includes a special radar film viewer-printer which allows the interpreter to view an enlarged projection of the image of selected frames, make necessary annotations, and then print both an enlarged print and a strip of edited, annotated radar film.

The first issue of *Flight Recorder*, published by Flight Research Inc., 116-55 Queens Blvd., Forest Hills 75, N.Y., describes the firm's Multidata camera Model III B, which succeeds Model II. The new model features operation to 212 F, new synclutch, 400-cycle motor, new cable connector and cable, external master-slave switch and new shutter. It is interchangeable with Model II and available at the same price of $1100.

The new publication, which will appear "about once every six weeks," according to the announcement, contains technical information and illustrations of the company's new products and developments.

Formerly Flight Research Engineering Corp., the company was reorganized in 1953 under its present name. While continuing research and development activi-

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developed in fine-grain

developed in PRA 400

John I. Newell, Western Cine Service Inc. of Denver, Colorado says of PRA 400, "Two years ago we obtained a sample of the Hoffman Laboratories developer known as PRA 400. This formula had been very successfully used for fine-grain development of still film. OUR TESTS INDICATED THAT IT WOULD BE VERY WELL SUITED FOR MOTION PICTURE FILM DEVELOPMENT."

Enough of the prepared powder was obtained to mix 20 gal of developer plus a supply of the PRA 400 replenisher formula. "THIS INITIAL SOLUTION HAS BEEN USED TO PROCESS NEARLY 100,000 FT. OF NEGATIVE FILM IN THE PAST YEAR. THE INHERENT KEEPING QUALITY FAR EXCEEDED EXPECTATIONS. At standard ASA ratings, films were immersed for 2 min at 72 F in this developer. DELIVERY RATE TRIPLED OVER THAT OBTAINED WITH D-76 AND THE COST OF CHEMICALS WAS REDUCED.

"Image quality was noteworthy, grain at a minimum, even in forced processed negatives. Contrast remained normal throughout the scale of the film. No staining or spotting problems have ever been encountered. Direct comparisons of identical negative materials processed to equal gamma in PRA 400 and D-76 have been made. The PRA 400 has proven to be a finer-grain formula. In terms of density range, PRA 400 and D-76 are quite similar. On several occasions Eastman Type 7302 release positive was processed in this developer. The low-contrast result was well suited for telecasting. Kinescope recording film Type 7374 responded very well and proved quite simple to achieve the indicated gamma of 1.1 consistantly. IN POINT OF FACT, WE HAVE BEEN ABLE TO PINPOINT OUR CONTROLS WITH FAR LESS DRIFT THAN EVER BEFORE."

PRA PRODUCTS, INC.

distributed by HOFFMAN LABS., INC.

350 W. 50th ST., NEW YORK, N.Y.

ties, it also manufactures photographic data-recording equipment under the trademark Multidata. Represented west of the Mississippi by Traid Corp., Encino, Calif., the company also has distributor agreements with Neyhart Enterprises, Inc., Rolling Hills, Calif. and Huber Industries, Cincinnati.

Establishment of Space Technology Laboratories as an autonomous operating division of the Ramo-Wooldridge Corp., 5500 W. El Segundo Blvd., Los Angeles 45, has been announced. The new division is an outgrowth and extension of the former Guided Missile Research Div., a unit of the company responsible for the technical direction and systems engineering for certain developments of the Air Force Ballistics Program.

A newly established division of Cohu Electronics, Inc., San Diego, Calif., will conduct a program of research and development in the fields of electronic instrumentation and process control. The new unit will maintain laboratories at 14743 Lull St. and will be under the direction of Martin L. Klein.

United Testing Laboratories, 573 Monterey Pass Rd., Monterey Park, Calif., is a recently completed facility of United Electrodynamics, 1200 Marengo Ave., Pasadena, Calif. The building occupies 18,000 sq ft in a 30,000 ft area. Atmospheric controlled electronic laboratories occupy 7500 sq ft, and 10,500 sq ft additional floor space is given to the general mechanical and environmental testing area.

The new facility includes a gyroscope system testing laboratory and a program is now underway to evaluate and supply reliability and safety data on various fusing systems for the Ordnance Divisions of the Army and Navy. In addition to the gyro and fusing laboratories there are laboratories for research and testing of standards, electronic components, electronic systems, instruments and electromechanical equipment. A recent acquisition is a 50 cu ft high altitude chamber that will simulate the change from sea level to 60,000 ft in 30 seconds and attain an altitude of 300,000 ft.

The complete facility is for the use of industry on either a project or a long-term continuing basis.

A system for transmitting pictures over telephone lines by slow-scan television has been announced by General Electric Technical Products Dept., Electronics Park, Syracuse, N.Y. The system was developed for military use and the first installation is planned for early this year. Technical details are unavailable because of security regulations, but it has been reported that the telephone-TV reproduces televised pictures at the rate of one image in 5–10-sec intervals instead of the usual 30 frames/sec in commercial television.

A closed-circuit color TV system has been installed at the underground headquarters of the Strategic Air Command at Offcut Airforce Base, Omaha, Nebr., by Radio Corp. of America. The system will be used to transmit briefing information, air intelligence and weather data to any one, or a combination of, key viewing locations throughout the A-bomb-proof underground structure.

The installation includes five live color TV cameras; a 3-vidicon color TV camera system for integration of filmed material; a monochrome industrial TV camera for surveillance of personnel entering the Operations Control Room; special remote-control equipment; associated power and program-switching systems; and 21-in. color TV monitors. Complete control facilities are in a centralized control room.

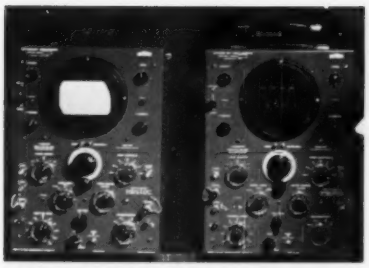
The daily briefing, intelligence and weather colorcasts are programmed in the control room which also receives signals from the color cameras. Special switching equipment enables the control room operator to feed any combination of the five incoming signals to any combination of the receiver locations. Three of the five color cameras are located in the Operations Control Room, a fourth is installed in the Air Intelligence Room, and the fifth is ceiling mounted in the Weather Room where it overlooks a special weather-vision table which permits rapid adjustment of weather maps to conform with changing conditions.

A "pure-picture" 21-in. TV monitor has been announced by Radio Corp. of America to provide broadcasters with a new high standard for testing and evaluating the performance of station color studio and transmitting equipment. The RCA Broadcast and TV Equipment Dept. reports technical advances including feedback stabilization, kinescope protection from loss of horizontal deflection or video overdrive, and regulated voltages for stability. The monitor can be adjusted without the aid of an oscilloscope. A built-in test switch is provided together with a screen-grid selector switch for quick viewing of primary colors. It is priced at $3,650.

An animation process developed by Colortech Films, 446 W. 43 St., New York, uses electronics to create motion and color from single black-and-white still photographs or line drawings. Colored artwork, as well as black-and-white, can be used as the basis for the animation if, for any reason, it is desirable to do so.

The process, based on a method of electronically modulating or changing a waveform, is being developed for many potential applications including commercials, fantasies in color and form, unusual motion-picture shorts, and educational uses. The first step in the process is to convert picture information to a waveform. The waveform is then altered by the Colortech process. When the picture resulting from the modulated waveform is filmed and reproduced, the original picture has acquired motion. It appears to change in form or size and can move in any direction in accordance with the will of the technician. The electronically added color is reported luminous and vibrant, creating unusual effects. The process can also be used in superimposing cartoons on conventional motion pictures.

This new method of animation is the culmination of 10 years of research and has been demonstrated at the Johnny Victor Theatre of the RCA Exhibition Hall in New York.



A black-background screen designed for electronic picture viewing under high ambient light conditions has been developed by Allen B. Du Mont Laboratories Inc., 750 Bloomfield Ave., N.J. Described as a "black phosphor" screen it is reported to be the first successful application of a black-background to a phosphor film. Applications include military, industrial and laboratory purposes where daylight viewing or viewing under bright light is necessary or desirable. It is immediately adaptable to airborne cockpit radar equipment. Pictured above is the screen retaining the image while the standard cathode-ray tube screen, at the left, is blanked out by high powered flood light.

Permafilm Inc., 117 W. 48 St., New York 36, has granted a franchise to Magneson of Barcelona and Madrid, Spain, for the processing and distribution of its product. In addition to supplying motion-picture laboratories, the Spanish firm will package the product for the amateur market.



These notices are published for the service of the membership and the field. They are inserted three months, at no charge to the member. The Society's address cannot be used for replies.

Positions Wanted

Top Animation Cameraman and technician with over 10 yr experience and 3000 commercial or show direction and production credits, desires position with live studio or TV station. Have own equipment including servo-automatic animation stand, adapted Mitchell 35mm camera, 35mm optical and magnetic recording equipment, rotoscopes, 3-D cameras, complete machine shop, still equipment. Experience as mixer, live cameraman, TV camera editor, art director, puppets, color processor, machinist, set construction, etc. Will relocate anywhere throughout the world. Write: Animated commercials, Inc., 451 West 50 St., New York 19.

Motion-Picture Production. Film student currently studying film at Institute of Film Techniques evenings, wishes full-time job in production, preferably in New York area. Recently finished ½-hr film at amusement park in N.J.; now working on experimental color film using animation. Energetic, with knowledge of many phases of film production; main interest and ambitions are in cinematography. Own 16mm equipment. Write: Leonard DeMunde, 534 Tillman St., Hillside 5, N.J.

Motion Pictures. Argentine, age 43, married, relocating permanently in U. S., seeks position with opportunity for advancement, preferably in California. 23 yr experience in photography, 12 yr teaching at government school; head of motion-picture dept. of local engineering college; familiar with most technical problems; lineal drawing; degree in optics; writer for photog. magazines; workable knowledge English language. Would prefer work in color lab but would consider other positions. For detailed information write or cable: Juan Esnaola, Lagos 1210, Rosario, Argentina.

Engineer-Photographic. Extensive experience in design and development of military and consumer opto-electromechanical photographic products and instrumentation. Capable of assuming complete responsibility from creative inception to acceptable prototype. Experience in manufacturing procedures, design simplicity and parts interchangeability. Seeking project assignment or part-time engagement. Foto, 495 Hempstead Turnpike, W. Hempstead, N. Y.

Administrative Engineer. The SMPTE's former Staff Engineer, Henry Kogel, is seeking a new position, after 6 years working with SMPTE Engineering Committees and the motion-picture standards program; also serving as Secy, American Standards Assn. Sec. Committee PH22, and Tech. Secy, International Standardization Orgn. Tech. Com. 36, Cinematography; 2 years, previously, develop. engr. with Sperry Gyroscope Co.; B.S. Elec. Eng., Columbia Univ., 1948, after military service as radio off.; recently sales engineer with Century Lighting Inc.; age 38; married; complete resume upon request. Henry Kogel, 19–24 202 St., Bayside 60, N.Y.; Tel. BAyside 9-3574.

Film and TV Production Supervisor. Thirty yr theatrical, industrials, trailers and TV commercials. Ten yr advertising agency experience in radio and TV productions. Will relocate. Resume on request. Write: Don McClure, 4 Pasture Lane, Darien, Conn.

Cameraman-Editor and Production Man wishes position with industrial, educational or commercial film producers. B.A. Univ. Miami in radio-TV-film productions. Worked as news cameraman and editor for local TV station. Presently employed as editor and assistant cameraman with producers of industrial films and TV commercials. Married, one child, willing to relocate. Read, write, speak Spanish. Resume available. Write: Sidney Platt, 300 S.W. 31 Ave., Miami 35, Fla.

Writer-Director-Editor. Experienced in all phases film production, from dealing with sponsors to negative cutting. Have written and/or edited theatrical, television and industrial films. Considerable experience in sound recording and dubbing. Educational background includes work at Cornell, Columbia and USC Dept of Cinema. Desires permanent position with New York industrial film company. Resume on request. Write: E. S. Seeley, Jr., 91 Remsen St., Brooklyn 1, N.Y. Tel: ULster 2-1037.

Motion-Picture Engineer. Formerly Technical Supervisor, The Michael Todd Co., Inc. Expert all technical phases motion-picture production and exhibition. Specialized work with all wide-screen systems now in use. Professional background includes responsible positions in production and exhibition with: The Todd-AO Corp., NBC-TV, CBS-TV Newsfilm, 20th Century Fox, RCA Victor, Altec Service Corp. and others. Qualified engineering draftsman. College major: Radio-TV-Motion-Pictures. Age: 32; health: excellent. Seeking interesting, challenging position. Presently employed motion-picture recording. Willing to relocate. Carl E. Warner, 141–60 84th Rd., Jamaica 35, N.Y. Tel: Hickory 1-3357.

Positions Available

Design Engineer. Responsible for product design of new products in field of photog. and meteorological instrumentation based on specification and design parameters supplied. Must have: degree in mech. eng., knowledge of electrical and electronic principles desirable; 3 yr exp. product design or detailed board design in optical or photog. instrumentation and/or mech. or mech.-electrical instrumentation and/or precision devices for low to medium production volume; 1 yr prod. eng. or equiv. exp. in eng. liaison, prod. prototype planning or testing; considerable knowledge machine tools, sand and die casting techniques, material finishing processes, standard fasteners, bearings and other mech. hardware. U. S. citizen. Salary: $650–850 per month. Write: George Bingham, Beckman & Whitley, Inc., 973 San Carlos Ave., San Carlos, Calif.

Development Engineer. Responsible for creative engineering, development tests and experimental design of proposed products. Must have: degree in mech. eng. or eng. physics; thorough knowledge theoretical and applied eng. principles in mechanics, materials, optics, and some electronics; 2 yr exp. with optical devices and/or mech. or mech.-electrical instruments and/or cameras or photog. instrumentation; 3 yr exp. in development or research on precision mech. or elect. devices; high degree creative eng. ability, ability to perform detailed math. analysis of applied eng. problems and outstanding record of performance. U. S. citizen. Salary: $650–800 per month. Write: George Bingham, Beckman & Whitley, Inc., 973 San Carlos Ave., San Carlos, Calif.

Executive Personnel. Expanding 16 & 35mm film company with modern equipment in new building seeks competent, qualified and conscientious executive to take responsibility for lab work, producer's services, sound, animation and direction of production. Permanent position with security. Experience in some or all phases of operation essential; applicant should be interested in more than a routine job; opportunity for profit sharing and possible ownership. In application, give age, education, experience and salary requirements. All replies in strictest confidence. Write: Lab, P.O. Box 411, Dallas, Texas.

Mechanical-Optical Engineer. Must have M.E. background with extensive and intimate knowledge of long focal length optics. Work will involve evaluation and improvement of large tracking telescopes and other optical systems used in missile range instrumentation. Applicants should have the educational and experience background to assume heavy project responsibilities. Salary commensurate with capability, plus outstanding bonus arrangement. Positions are located at Air Force Missile Development Center, Holloman, New Mexico, 10 miles southwest of Alamogordo, N.M. Contact W. F. Goodwin, Personnel Administrator, Land-Air, Inc., Box 394, Holloman, N.M.

Medical X-Ray Film Technical Sales. Unique opportunity with national distributor of medical X-ray film for man with at least 2 yr chemical engineering college and exceptional selling personality. Must have knowledge of medical X-ray film developing, testing and evaluation in order to demonstrate film. Zest, initiative and get-up-and-go are also a must. Starting as salesman in New York area, position as technical sales manager will be open to applicant proving his mettle. Good salary plus commission with genuine growth opportunity. Write qualifications and experience to: L. Monteleoni, 1105 Park Ave., New York 28.

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Meeting Calendar

IRE, AIEE, U. of Penn., Symposium on Transistors, Feb. 20–21, U. of Penn., Philadelphia.

Audio-Visual Commission on Public Information, Quarterly Meeting, Mar. 10–12, Syracuse, N. Y.

Electronic Industries Association (formerly RETMA), March Quarterly Meeting, Mar. 15–17, Sheraton Park Hotel, Washington, D. C.

IRE National Convention, Mar. 24–27, New York.

Inter-Society Color Council, 27th Annual Meeting, Mar. 25–26, Sheraton-Park Hotel, Washington, D. C.

Optical Society of America, Mar. 27–29, Sheraton-Park Hotel, Washington, D. C.

Microwave Research Institute, Polytechnic Institute of Brooklyn, Symposium on Electronic Waveguides, Apr. 8–10, Engineering Societies' Bldg., 33 West 39th St., New York.

IRE, AIEE, ASME, Conference on Automatic Techniques, Apr. 14–16, Statler Hotel, Detroit.

83rd Semiannual Convention of the SMPTE, including Equipment Exhibit, April 21–26, Ambassador Hotel, Los Angeles.

PGCP, AIEE, EIA, WCEMA, Electronic Components Symposium, Apr. 22–24, Ambassador Hotel, Los Angeles.

Electrochemical Society, Apr. 27–May 1, Statler Hotel, New York.

National Academy of Sciences, Annual Meeting, Apr. 28–30, Washington, D. C.

NARTB, 36th Annual Convention, Apr. 28–May 1, Biltmore & Statler Hotels, Los Angeles.

Professional Group on Microwave Theory and Techniques, National Symposium, May 5–7, Stanford U., Stanford, Calif.

Acoustical Society of America, Spring Meeting, May 7–9, Washington, D. C.

Society of American Military Engineers, 38th Annual Meeting, May 20–21, Washington, D. C.

Armed Forces Communications and Electronics Association, National Convention, June 4–6, Sheraton Park Hotel, Washington, D. C.

National Audio-Visual Association, Annual Convention, July 26–29, Morrison Hotel, Chicago.

WESCON, Aug. 19–22, Ambassador Hotel, Los Angeles.

Fourth International Congress on High-Speed Photography, including Equipment Exhibit, Sept. 22–27, Cologne.

Society of Photographic Scientists and Engineers, Annual Technical Conference, Oct. 6–10, Manger Rochester Hotel, Rochester, N.Y.

Optical Society of America, Oct. 9–11, Hotel Statler, Detroit, Mich.

National Electronics Conference, Oct. 13–15, Hotel Sherman, Chicago.

84th Semiannual Convention of the SMPTE, Oct. 20–24, Sheraton-Cadillac, Detroit.

American Standards Association, Ninth National Conference on Standards, Nov. 18–20, Hotel Roosevelt, New York.

Acoustical Society of America, Nov. 21–23, Chicago, Ill.

85th Semiannual Convention of the SMPTE, including International Equipment Exhibit, May 4–8, 1959, Fontainebleau, Miami Beach.

86th Semiannual Convention of the SMPTE, including Equipment Exhibit, Oct. 5–9, 1959, Statler, New York.

87th Semiannual Convention of the SMPTE, May 1–7, 1960, Ambassador Hotel, Los Angeles.

88th Semiannual Convention of the SMPTE, Fall, 1960, Shoreham Hotel, Washington, D. C.

89th Semiannual Convention of the SMPTE, Spring, 1961, Royal York, Toronto.

90th Semiannual Convention of the SMPTE, Oct. 15–20, 1961, Statler, New York.

SMPTE Officers and Committees: The rosters of the Officers of the Society, its Sections, Subsections and Chapters, and of the Committee Chairmen and Members were published in the April 1957 Journal.

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